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DEPRESSED NASAL DEFORMITIES. A COMPARISON OF THE PROSTHETIC VALUES OF PARAFFIN, BONE, CARTILAGE AND CELLULOID, WITH REPORT OF CASES CORRECTED WITH CELLULOID IMPLANTS BY THE AUTHOR'S METHOD.

By JOSEPH D. LEWIS, M. D.,

SURGEON-IN-CHIEF, DEPARTMENT OF EYE, EAR, NOSE AND THROAT, MINNEAPOLIS GENERAL HOSPITAL,

MINNEAPOLIS.

The common types of depressed nasal deformities may be classified as (pronounced) retroussé nose, saddle nose and depressions of the nasal tip. Other varieties, usually resulting from injuries, are seen as combinations of these types.

One of the following three methods may be employed for the correction of external nasal depressions by buried prosthesis:

1. Subcutaneous injections of paraffin.
2. Autogenous transplants of bone or cartilage.
3. Celluloid implants.

These methods will be considered separately, in the order mentioned, and discussed on a basis of comparative value.

PARAFFIN.

The correction of depressed nasal deformities by internal prosthesis had its beginning in 1900, when Gersuny¹ injected subcutaneously white vaselin (also known as medicinal vaselin, which melts at 104° F.), for the correction of a saddle nose. Shortly afterward, Delangre,² for the same purpose and in like manner, used spermaceti. Eckstein,³ in 1901, used pure paraffin with a fusing point of 140° F. Later observers, however, found that a mixture of vaselin and paraffin having a melting point ranging from 110 to 136 degrees F. is preferable.

The ease with which nasal depressions, even of marked degree, may be restored to normal contour by the injection of paraffin gave to this method an immediate and wide vogue, and reports of many cases in which this material was used appeared in the literature of the subject.

The paraffin method, largely because of the simplicity of technic, was promptly adopted by charlatans, who recklessly abused the procedure; but, even in competent hands, this method did not long survive, owing to the appalling end results noted in a considerable percentage of the cases.

Harmon Smith⁴ has published a very comprehensive statistical report, based on information collated through a questionnaire, comprising 1,252 cases (exclusive of his own) in which paraffin prosthesis was used. The following is the statistical summary deduced from answers received from forty-one different observers: At the time of compiling the data 1,000 of the cases reported were entirely successful; in 104 the results were unsatisfactory. Two of the 104 cases resulted in blindness, in 55 sepsis and extrusion of the mass followed, in 22 the paraffin lodged in the wrong location, and in 7 the mass subsequently shifted. In his own 200 cases, in which paraffin was employed, unsatisfactory results occurred in two.

The melting point of the mixture of vaselin and paraffin injected ranged from 103 to 136 degrees F., the majority of the observers using a mixture having a melting point of 110° F., as originally suggested by Smith. Thirty-one of the forty-one observers considered the procedure practicable in the hands of an experienced operator, if proper precautions were

observed, the remaining ten regarding it as dangerous and in most cases unwarrantable.

Connell and Kolle,⁵ adding to Smith's statistics of the untoward sequelæ following the use of paraffin, have tabulated a total of twenty-two complications which may follow its use. Later consequences, not included in the aforementioned reports, have appeared in the form of keloid and paraffinoma.

In my earlier work paraffin, having a melting point of 120° F., was used in six cases for the correction of concave nasal deformities of moderate degree, fortunately, without any untoward results; but the evidence before us seems sufficient to condemn a procedure which all too often has been followed by disastrous consequences.

BONE.

Bone grafts may be obtained from the rib, crest of the tibia, ilium, free vertebral border of the scapula, as suggested by Lothrop,⁶ or from the turbinal bodies.

It is a well recognized fundamental principle of bone surgery that successful bone transplplantation is largely dependent on the osteogenetic activity of other bones to maintain continued viability of a graft. Therefore, it is essential to permanence that a graft used to restore nasal contour be placed in close juxtaposition to the frontal bone, because osteogenesis provided by the small and thin nasal bones is inadequate. At best, bone to bone contact can be effected only at one end of the graft. The proximal portion, which rests free in the soft tissues at the nasal tip is, therefore, removed from any contact with the bone.

We shall see, as we proceed, that the opinions of observers are divided respecting the ultimate fate of bone grafts transplanted into the nasal tissues, as well as regards the influence of the periosteum on their permanence.

Carter⁷ reports cases of depressed nasal deformities corrected with bone prosthesis which show no clinical changes after many years. His radiographic studies indicate that the outer layers of bone transplanted into the nasal tissues remain unchanged, whereas the central portions, being more remote from the circulation, reveal definite signs of absorption, which he thinks is probably due to impaired nutrition. At that time (1910) he believed the periosteum essential to the viability of

bone grafts; also that contact with the raw frontal bone is of the highest importance—being secured only when the periosteum has been elevated and the underlying bone denuded with suitable instruments.

As to the value of periosteum, this writer⁸ subsequently revised his views and advocates its removal for the reasons that he believes bare bone is better nourished by the connective tissue which soon surrounds it and, since there is no desire to grow new bone, the osteogenetic layer of the periosteum serves no function. He summarizes additional reasons as follows: "The periosteum is removed from the grafts because: (1) It is easier to resect a rib without injuring the pleura by shell-ing it out of its periosteum, and besides, it is desirable to leave the periosteum for the reconstruction of the rib. (2) The bare bone is more quickly and surely nourished by the connective tissue envelope which quickly surrounds it. (3) The osteo-genetic layer of the periosteum can be dispensed with since we have no desire to grow new bone, but to nourish the trans-planted tissues."

Carter⁹ says further: "The influence of the periosteum as an osteogenetic factor is pronounced, and its absence is equally marked. This osteogenetic function is more marked the younger the patient. At the same time I say that I have not found the periosteum necessary in correcting nasal deformities, but the transplants are in a more flourishing condition in those cases where I have preserved the membrane."

Subsequently Carter¹⁰ proposed a modification of the older method, advocating the use of a graft composed of one inch of periosteum covered rib and one-half inch of costal cartilage; the object of this is to supply bone where it normally exists with the cartilaginous portion extending into the nasal tip to preserve its normal flexibility.

For the same reasons, Cohen¹¹ also favors a rib graft composed of conjoint bone and costal cartilage.

More recently Carter¹² states: "My clinical cases appear to show that bone is formed by the so-called periosseous osteo-genetic layer of the periosteum, and that the cells of this layer are protected and their growth limited by the connective tissue."

It now seems pertinent to the subject under discussion to

set forth the facts which have led other investigators to the opposite view respecting the ultimate fate of transplanted autogenous grafts and to inquire further into the value of the method.

According to Ferris Smith,¹³ * * * "free plants of bone with or without periosteum into the soft tissues are slowly absorbed. Bone which is turned with a flap without separation of its periosteum, but unattached to other functioning bone, is partly or wholly absorbed, leaving a dense scar which furnishes some support. The difficulty in shaping or handling bone under these conditions practically excludes it as a means of support."

Sheehan¹⁴ also holds that bone transplants, with or without periosteum, are often slowly absorbed, and therefore believes that the method should be discarded.

The exhaustive experimental studies on dogs conducted by Davis¹⁵ to determine the comparative permanence of free bone and cartilage transplants throw considerable light on the relative value of the two. The grafts of cartilage and spongy bone were taken from the rib and the hard bone from the fibula. The plants were inserted beneath the periosteum of the temporal bone, a part of which was placed in contact with the denuded parietal bone, the remaining portion being buried in the temporal muscle. He showed that under the same conditions the behavior of transplanted cartilage and spongy rib bone is quite different: that the cartilage retains its original size, while bone shows a tendency to absorption, which slowly progresses. Later,¹⁶ reiterating these views, he summarizes his conclusions as follows: * * * "my experience has been that a free bone transplant in soft parts will eventually be absorbed and, when in contact with bone at only one end, will eventually atrophy. * * * Those who begin with the use of bone will eventually turn to cartilage as the best material for the construction of a framework for the nose."

The opinion of Gillies,¹⁷ based on a broad experience in the use of bone grafts in various parts of the face and head, is that they eventually absorb and are replaced by a deposit of fibrous tissue, the clinical results depending on the amount of new formed tissue, which, in a fair percentage of the cases, is sufficient to leave the cosmetic result unimpaired to any appreciable degree. Bearing on this point, Hays¹⁸ has described a

case in which three months after a bone graft had been placed in the nasal tissues, it was removed because of persistent infection, and he was happily surprised to find that sufficient connective tissue had been deposited to fill the original concavity.

I also have observed the same phenomenon following the extrusion of a gold implant which had remained in the nasal tissues for several years. Similar observations have been reported by others in the literature on heteroautoplasty.

Thus there is a preponderance of evidence, deduced from the lessons drawn from animal experimentation and clinical observations, which strongly speaks against bone transplantation for the correction of nasal deformities. Seemingly, the method has proved disappointing for manifold reasons, to wit: (1) It is quite impossible to fashion a bone graft so that the result will impart a naturalness to the nose; (2) in order to effect contact with the frontal bone—the source of osteogenetic activity—the plant, in arching across the infraglabellar notch, gives to the nose an appearance similar to the classic type of the ancient Greeks, which does not appeal to the modern esthetic sense; (3) it would seem that depressions of the nasal tip are hardly amenable to correction with bone, for, if viability depends on contact with other bone, necessarily the graft must extend from the tip to the frontal bone, thus elevation of the dorsum of the nose would follow and largely impair or even negative the cosmetic result; (4) infections about the rib area have not been uncommon, and even more serious complications have followed as a result of wounding the pleura, including pneumothorax and empyema. While not of frequent occurrence, the possibility of these complications must be considered; (5) two other factors which may act as deterrents to both patient and surgeon are the inconvenience to the patient occasioned by the operation and the mutilation of the chest wall attending it; (6) and finally, the fate of bone transplanted into the nasal tissues is, at best, very uncertain, the consensus of competent opinion being that it is eventually absorbed.

CARTILAGE.

Cartilage transplantation is a method originally evolved by von Mangoldt¹⁹ in 1899, who used a disk of rib cartilage to

supply tissue insufficiency in an external operation on the larynx. His method, slightly modified, is still the accepted one.

Nélaton²⁰ was the first to employ rib cartilage for the purpose of supplying nasal deficiency. The cartilage was first planted into the forehead, between the skin and the periosteum, and later a pedunculated flap composed of skin, cartilage plant and periosteum was detached and swung down into position, the embedded cartilage serving to prevent sinking of the newformed nose.

Grafts of septal cartilage claim but passing interest inasmuch as there is complete unanimity of opinion among observers that they are always absorbed, fading away so promptly that fibrous tissue has not time to replace the departed visitor. Furthermore, since septal cartilage cannot be obtained sterile, the inseparable element of infection is introduced, rendering the procedure surgically unsound. Cartilage from this source being largely composed of yellow elastic tissue probably satisfactorily explains its inherent absorptibility. On the other hand, cartilage from the rib or sternum may be obtained uncontaminated, and, if desired, with more or less of its perichondrium intact.

The viability of cartilage is not dependent on either contact with bone or cartilage, living, according to Ferris Smith, by lymph absorption—remaining as before introduction when divested of its perichondrium and probably growing when it has been preserved.

As a result of the knowledge gained from a study of a series of twenty-four experiments on dogs, supplemented by his clinical observations, Davis²¹ considers transplantation of rib cartilage a meritorious method for the correction of saddle nose. He has determined by microscopic studies that transplanted cartilage becomes surrounded by a zone of loose connective tissue containing blood vessels, the vascularization varying according to the length of time a plant has been imbedded. The cartilage cells appeared normal, and there were no evidences of absorption, degeneration or increase in the length of the plant—in a word, this competent research worker concludes, from these and other animal experimentations previously referred to, that perichondrium covered cartilage, when transplanted into flaps with skin on two

sides and having an adequate pedicle supply to provide nourishment, is a feasible surgical procedure.

Beckman's²² observations lead him to the conclusion that cartilage is preferable to bone as a supporting material for the relief of depressed deformities of the nose and that it is neither essential to preserve the perichondrium nor to have contact with bone or other cartilage to maintain viability.

As has already been pointed out, Gillies likewise prefers cartilage to bone. As to the permanence of cartilage, he says: "In only a few of the homologous grafts has the cartilage become replaced by fibrous tissue as a late sequel." The longest period of time that a graft had been under his observation is three years.

Cohen²³ states that in his experience the use of cartilage alone has not proved wise for the following reason: "Such grafts never form union with bone and are, therefore, never firmly fixed on the nose; they are always absorbed to a greater or less degree."

Selfridge²⁴ also has noted the absorption of cartilage transplanted into the nasal tissues, particularly instanced in a case reported where three attempts were made before he attained his end. First, a piece of cartilage taken from the rib and sternum was absorbed. Here, as in another case reported in the same article, he met with infection of the rib area. At the second operation he transplanted septal cartilage which became infected and it was necessary to remove it. Finally, again using sternum cartilage, a satisfactory result rewarded his pertinacity.

A survey of the foregoing opinions of those who have studied the comparative merits of bone and cartilage brings us to an apparent point of agreement, to wit: That cartilage is preferable to bone as a supporting material for the correction of depressed nasal deformities. But, as we have seen, there is a divergence of opinion as to the permanence of transplanted cartilage. This important question remains to be definitely determined by the test of time and therefore we must await tomorrow's answer.

In some respects cartilage prosthesis has advantages over bone. In other ways several distinctly weak features are

attached to the method, namely; cartilage lacks sufficient rigidity to provide adequate support for marked nasal depressions because the concavity cannot be spanned, and therefore correction must be accomplished by filling the depressions with cartilage. Although more easily shaped than bone, the fragility of cartilage renders it liable to fracture while being formed or as a result of manipulation incident to introducing it into the nasal tissues.

Cartilage, as we know, is more resistive to infection than bone, but when it occurs, as Gillies and others have pointed out, suppuration and necrosis may follow, and as a consequence a secondary deformity may be the terminal result.

Gillies has demonstrated that the chest wall remains permanently weakened after the removal of thoracic cartilage, because this tissue does not replace itself.

In final analysis one may be led to the conclusion that neither bone nor cartilage—in other words, autogenous tissue grafts—is to be viewed as a wholly satisfactory method for the relief of depressed nasal deformities.

CELLULOID.

The scant recognition accorded the celluloid method in America has, with few exceptions, been expressed in words of disapproval, the idea being rejected on the theory that foreign bodies are not tolerated by the tissues.

The general attitude displayed toward celluloid as a supporting material is reflected in the following quotations from the writings of several contemporary authors:

Ferris Smith:¹³ "A century of experience with all kinds of inorganic substances planted in soft parts has served to prove that only exceptionally is a foreign body kindly borne by the tissues: gangrene, skin atrophy or expulsion of the piece has been the usual experience. Recent workers make different claims for celluloid, and there are still enthusiastic supporters of hydrocarbon preparations, but after all is said both are foreign bodies."

Sheehan:²⁵ "Celluloid plates, * * * cannot be too forcibly condemned. They act as an irritant to the tissue, generally sooner or later giving trouble by abscess formation, gangrene, atrophy of skin and finally expulsion."

Beck:²⁶ "I have had no personal experience with celluloid implants, having rejected them on the ground that they were foreign bodies and would not be assimilated as well as the bone or cartilage graft, nor even as well as the paraffin."

But as these assertions are not based on any actual experience with celluloid or supported by the results of others who have employed this material, they fail to carry conviction. Nor can we view such postulates as in line with the spirit of scientific progress.

In expressing a preference for autogenous grafts, Gillies¹⁷ believes that inorganic substances act as tissue irritants and ultimately the tissues attempt to remove them—in fact, he found that the greater number of his celluloid implants had to be removed within two months of their insertion. While the opinion of one so finely qualified by exceptional experience carries great weight, there are several cogent reasons why failures should attend his endeavors, and therefore his results should not be taken as a true criterion. It is not surprising that he has recorded unsatisfactory results with the use of celluloid, nor is it difficult to see why this should be when we remember that the implants were introduced into tissues which previously had been traumatized by wounds of war, involving both cutaneous and deeper structures, producing, as a result, old scars, hematoma, impaired blood supply and, as a consequence of tissue devitalization, he constantly was troubled by infection. With the exception of one nasal case the operations in which celluloid was used were in other parts of the face.

Notwithstanding the adverse conditions under which he so patiently labored, two of Gillies' celluloid implantations proved successful: one plate healed in after an abscess, which developed over it, was drained.

Seemingly, this investigator, realizing that he labored against almost insurmountable obstacles, has not lost faith in celluloid as a prosthetic material, as, at his request, MacBride of the Imperial Research Laboratories is now carrying out a series of experiments on the implantation of collodion into the ears of mice.

The genesis of the celluloid plate idea is accredited solely to Fraenkel,²⁷ who used plates of this material to fill skull

defects. This fine example of originality and ingenuity has few parallels in the annals of surgery. He found that celluloid plates, when snugly fitted, cause no reaction in the neighboring tissues years after their application. He cites two cases of cortical epilepsy in which the skull defects produced by decompression were replaced with celluloid plates. The results were good seventeen and twenty-five years, respectively, after operation. In referring to Hintersteisser's brilliant results, he says that this observer, who has had wide experience with the method, never found reason to remove a depressed celluloid plate from the skull.

Föderl²⁸ was the first to employ celluloid in plastic operations for the restoration of the nose, using a thin sievelike triangular shaped plate which he interposed between the periosteum of the skull and the skin of the forehead. Allowing the wound to heal, he completes at a second operation by cutting a pedunculated graft containing the skin, periosteum and imbedded celluloid plate, which is brought down and stitched into the desired position to replace the destroyed nose. The thin celluloid plate, being easily bent, serves to produce the desired shape and also to prevent sinking of the bridge of the new-formed nose. He reports two cases in which this method was used. In one, the greater part of the nose had been removed on account of a tumor, the other being a case of destruction of the nose by disease. In both cases the immediate results of the plastic operations were good, but the first patient died of a recurrence of the tumor. In the second, the shape of the nose was not entirely normal, and on account of the marked tissue destruction another plastic operation would be necessary around the mouth. The case was a very unfavorable one, and he thinks the result as good as could reasonably be expected or obtained by any method.

Koschier,²⁹ following Föderl's technic, describes two cases operated on by his method. In one the disfigurement was due to rhinoscleroma, the other being caused by lues. The results were excellent in both cases. On the whole, the author concludes that the celluloid plate method gives better cosmetic results, with a very simple operation, than other plastic methods done for the same purpose.

Thompson³⁰ has shown that celluloid filigree plates used in

operations for large herniæ and plates which are serrated or perforated near the margins, in operations on the skull, revealed no evidence of erosion after being in the tissues as long as three or four years. He found that when buried aseptically and unperforated the reaction caused by celluloid is so slight as to pass unnoticed, nor does it afterward cause any inconvenience.*

In expressing his preference for the celluloid method, he says: "Celluloid will be found advisable in preference to other material, such as transplanted bone phalanges, pieces of rib, etc., where the use of these is indicated in plastic operations on the nose for restoring the bridge, * * * producing a more artistic result, indeed I think a satisfactory one, which is more than can be said for the other crude procedures; moreover, it is not so liable to the necessity for removal for necrosis, with all its undesirable consequences, as in the other case."

Monks³¹ was the first in this country to use celluloid for the restoration of nasal contour—in fact, he was the first to transplant this material directly into the nasal tissues. He has reported two cases of saddle nose successfully corrected with celluloid implants, introduced into a tunnel made by way of an incision at the tip of the nose.

New³² implanted pieces of celluloid into the tissues over the nose in six dogs. In two, the wounds became infected; in the remaining four, the celluloid healed in with only slight reaction. The impressive results of these experiments led him to employ celluloid implants for the correction of depressed nasal deformities in man, in which the results were uniformly satisfactory in his five reported cases. He believes celluloid is preferable to either bone or cartilage.

The prejudice against celluloid has arisen wholly as a result of including this material in the category of foreign bodies which we know are not tolerated by the tissues and therefore have proved consistently disappointing. But it seems to have been demonstrated with certainty by a host of investigators and abundantly confirmed by my own results, that celluloid,

*A perusal of Thompson's illuminating article, dealing with the uses of celluloid in various parts of the body, may prove of interest to the general surgeon.

for reasons as yet not fully determined, is not a tissue irritant and therefore shows no tendency to extrusion, if introduced in reasonable quantities, through avenues amenable to sterilization and when the suture line is well removed from the prosthesis.

In sum, the evidence vindicating the celluloid method appears so ample and conclusive that I firmly believe it is destined to supersede all other procedures.

TECHNIC.

In striving to avoid a more or less conspicuous scar following an incision made for the introduction of a nasal prosthesis operators have shifted from one part of the nose to another.

The oldest method of effecting a subcutaneous tunnel is by way of a transverse incision at the root of the nose corresponding to that point where the bridge of a spectacle rests. The method has lost its former popularity for the following reasons: A disfiguring scar remains if not concealed by a spectacle bridge; the angular branches of the facial arteries are necessarily severed and require buried ligatures—a step not infrequently followed by infection; the angle formed by the glabella and bridge of the nose (infraglabellar notch) calls for a wide dissection over the nasal dorsum in order to gain space to extend the pocket to the tip of the nose. This, in turn, means that there is little to prevent lateral displacement of the prosthesis. The suture line being very near, or directly over the prosthesis, is distinctly disadvantageous, for the reason that the blood supply, having been impaired, aided by the pressure of the underlying prosthesis, the somewhat devitalized tissues fail to unite or the sutures yield from lack of resistance.

Recently Frank and Strauss,³³ aiming to minimize the scar, have proposed a modification of the preceding method, which briefly described is as follows: The initial incision is made in the eyebrow (in operations for broad nose, access is gained through both eyebrows), from which point the tissues over the infraglabellar notch and dorsum of the nose are elevated with specially designed angular elevators and cutting instruments. The sole advantage suggested by this method is that the scar is concealed by the eyebrow. But in entering from this point lies the apparent weakness of the procedure, as it

imposes an extremely difficult, perhaps impossible, technic to follow the contour of a hump or depression of the nose to the nasal tip with angular instruments without mishap. Furthermore, it follows that to introduce a prosthesis into a tunnel thus made would indeed prove a tedious technical step.

Monks³¹ advocates making the primary incision in the under surface of the nasal tip, from which point the tissues over the dorsum of the nose are released to form a pocket. This method has the virtue of simplicity and being free from conspicuous scar, closely approaches the ideal. However, as all internal prostheses exert a strong tendency to move in the direction of least resistance—in this instance, toward the initial incision at the nasal tip—the support afforded at the suture line often is inadequate, as previously pointed out, to prevent extrusion. I have thrice experienced such a misfortune after introducing a celluloid implant by Monks' method, and, I may add in this place, that several others who have had experience with implanted celluloid have emphasized the importance of having the material completely covered with tissue and also have stressed the danger of placing sutures close to the implant.

As a subcutaneous approach to the tissues of the nasal dorsum, Gillies favors making vertical incisions in the vestibule of each nostril near the junction of the skin and mucous membrane which are united by dividing the columna at its attachment to the upper lip. The columna is then dissected free, seized with a suitable instrument and drawn upward to expose the free border of the columella, above which a tunnel is effected toward the nasal arch. This elaborated surgical technic, which is really a double intranasal incision, plus a transverse division of the columna, seems altogether too extensive, therefore the procedure is likely to be appraised as one of doubtful value.

The intranasal method was evolved to avoid a cutaneous scar, but having several distinct disadvantages the measure has met with opposition because: The technic is difficult; it does not insure against lateral displacement of a prosthesis; the material introduced cannot be closed in with sutures; and, a fortiori, the method introduces the added and inseparable element of the danger of infection. Therefore it

would seem wise to avoid a method which is not in obedience to the well recognized principles of modern surgical procedure.

I have elsewhere³⁴ fully detailed the operative technic of a procedure for the introduction of nasal prostheses which seemingly leaves little to be desired, surgically or cosmetically. Briefly, the technical steps of the operation are as follows: A vertical incision is made in the lower half of the columna nasi (A.A. Figs. 1 and 2), the lips of which are undermined laterally toward the nasal vestibules.

Then, by upward cuts with a pair of small curved blunt scissors, the nasal tip is undermined and converted into a hood (B.B. Figs. 1 and 2). With the same scissors, introduced on the flat, the hood is elevated and the tunnel dissection continued as far as desired toward the infraglabellar notch (C. Fig. 2).

Summary of advantages: By first packing the anterior nares with gauze or cotton, the field is rendered amenable to sterilization; local anesthesia is wholly adequate; by working through the soft tissues at the base of the nose the parts are easily manipulated. Therefore it is not difficult to follow the contour of the nasal dorsum and, with little care, to carry the tunnel dissection toward the nasal bones without departing from the midline—hence, lateral displacement of a prosthesis is prevented; the support furnished by the tip hood secures against extrusion; the two or three sutures required to close the initial incision are well removed from the tunnel containing the prosthesis; and, lastly, the soft tissues of the columna promptly heal without scar (Fig. 3). In short, my results with this method lead me to believe that it is hardly possible to exaggerate its advantages.

REPORT OF CASES.*

Fig. 4 (Case 1).—A. A., aged 23, in 1909 sustained an injury by being thrown against a telegraph pole and again in 1916 during a football game, producing a depressed fracture of the right nasal bone and a dip between the nasal bones and the tip. June 5, 1918, the right nasal bone was refractured and reset by an intranasal operation. Six days later a celluloid implant was introduced through a transverse incision over the bridge of the nose to restore contour between the tip and nasal bones. This case has no special interest

aside from showing the length of time—more than four years—the celluloid implant has remained in situ, and the conspicuous scar produced by the transverse incision over the nasal bridge.

Fig. 5 (Case 2).—F. K., aged 15. Saddle nose of moderate degree. No history of injury being obtainable, this case is classified as a doubtful congenital deformity. Operation, July, 1921, celluloid implant introduced by author's method. Note absence of scar and naturalness of the nasal contour.

Fig. 6 (Case 3).—O. B., aged 60. Saddle nose of moderate degree resulting from a septal abscess. Procedure same as in preceding case.

Fig. 7 (Case 4).—H. G. D., aged 33. Depression of the nasal dorsum following a submucous resection of the nasal septum in 1915. Celluloid implant introduced as in preceding cases. Note the change in the shape of the nostril.

Fig. 8 (Case 5).—P. H., aged 27. Saddle nose and flattening of nasal tip due to injury in 1919. Celluloid implant shaped to correct the dorsal depression and elevate the tip.

Fig. 9 (Case 6).—B. D., aged 16. Injury to nose resulting from a fall, producing a retroussé deformity. A septal deviation almost entirely obstructed the left nasal chamber. Submucous resection of the nasal septum; later a celluloid implant was introduced by the author's method.

Fig. 10 (Case 7).—B. N. S., aged 9. Congenital depression of the nasal tip. April, 1920, celluloid implant introduced through a bridge incision (note scar) and removed a few days later, as it became displaced toward the suture line and was exposed. April, 1921, celluloid implant introduced into the tip by author's method, which was not sufficiently large to correct the deformity. February, 1922, attempt was made to remove implant introduced ten months previously, preliminary to inserting a larger one, but, owing to its having become securely encapsulated this was not possible, so a second implant was superimposed upon the first. (The two implants are shown in accompanying skiagraph.)

Fig. 11 (Case 8).—A. K., aged 26. Congenital hump and depression of the nasal tip. Through a columnar incision

*Only those of my twenty-three cases of celluloid implantation which have some special interest are herewith reported.

(A. Fig. 1) the hump was reduced with special rasps and immediately afterward the tip elevated by a suitably shaped celluloid implant.

Fig. 12 (Case 9).—J. C., aged 20. Congenital depression of the nasal tip. July, 1921, celluloid implant introduced by author's method, which was removed February, 1922, and another of different shape and somewhat larger introduced. At the time of removal of the first implant it was noted, by the resistance offered, that encapsulation was quite well established. Examination of the first implant under magnification showed no erosion.

Fig. 13 (Case 10).—K. A. M., aged 38. A submucous resection of the nasal septum was done December, 1917. Extensive sloughing followed, which completely destroyed the septum, producing a very ugly external deformity. Lues being suspected, a Wassermann test was made, which proved positive + + + +. Patient consulted me November, 1921, stating that he had received antiluetic treatment. Wassermann negative. November, 1921, a celluloid implant was introduced by the author's method. The result not being entirely satisfactory, the first implant was removed after twenty-five days and a larger one inserted.

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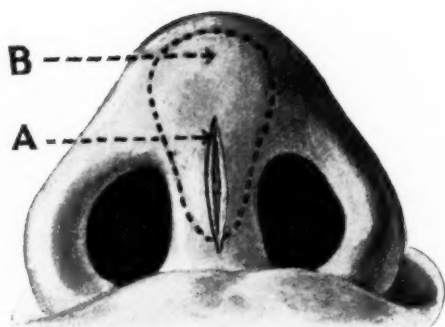
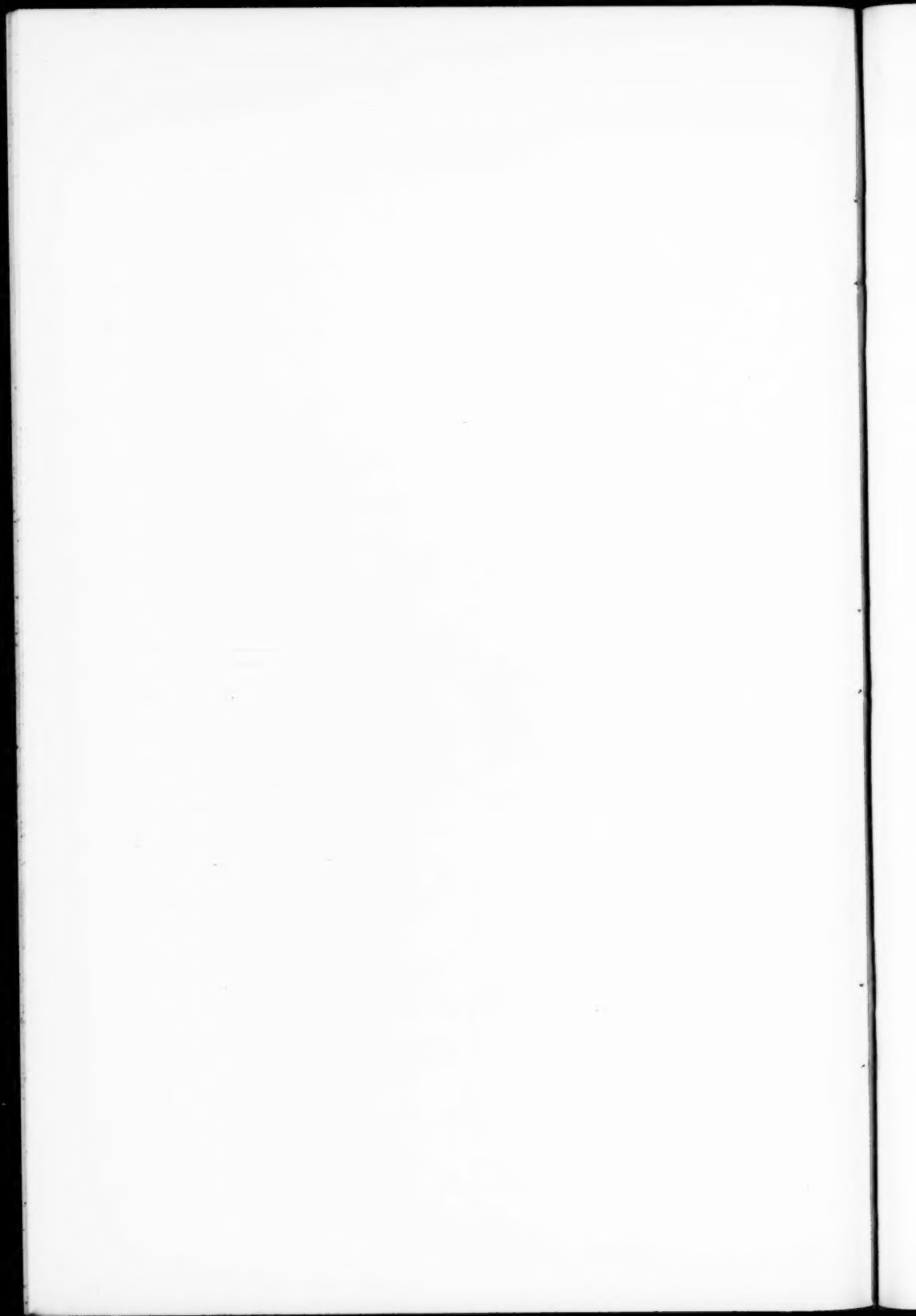


Fig. 1.



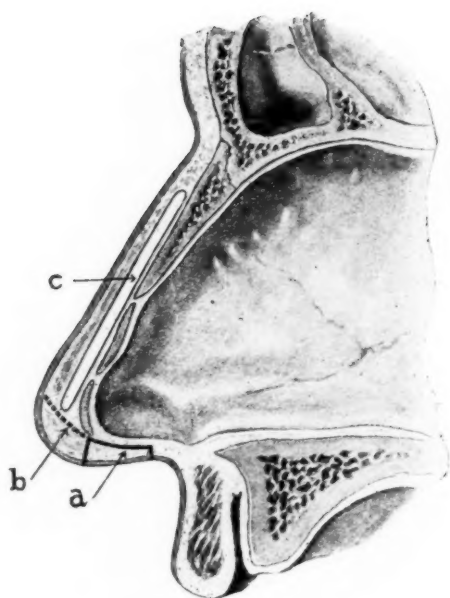


Fig. 2.

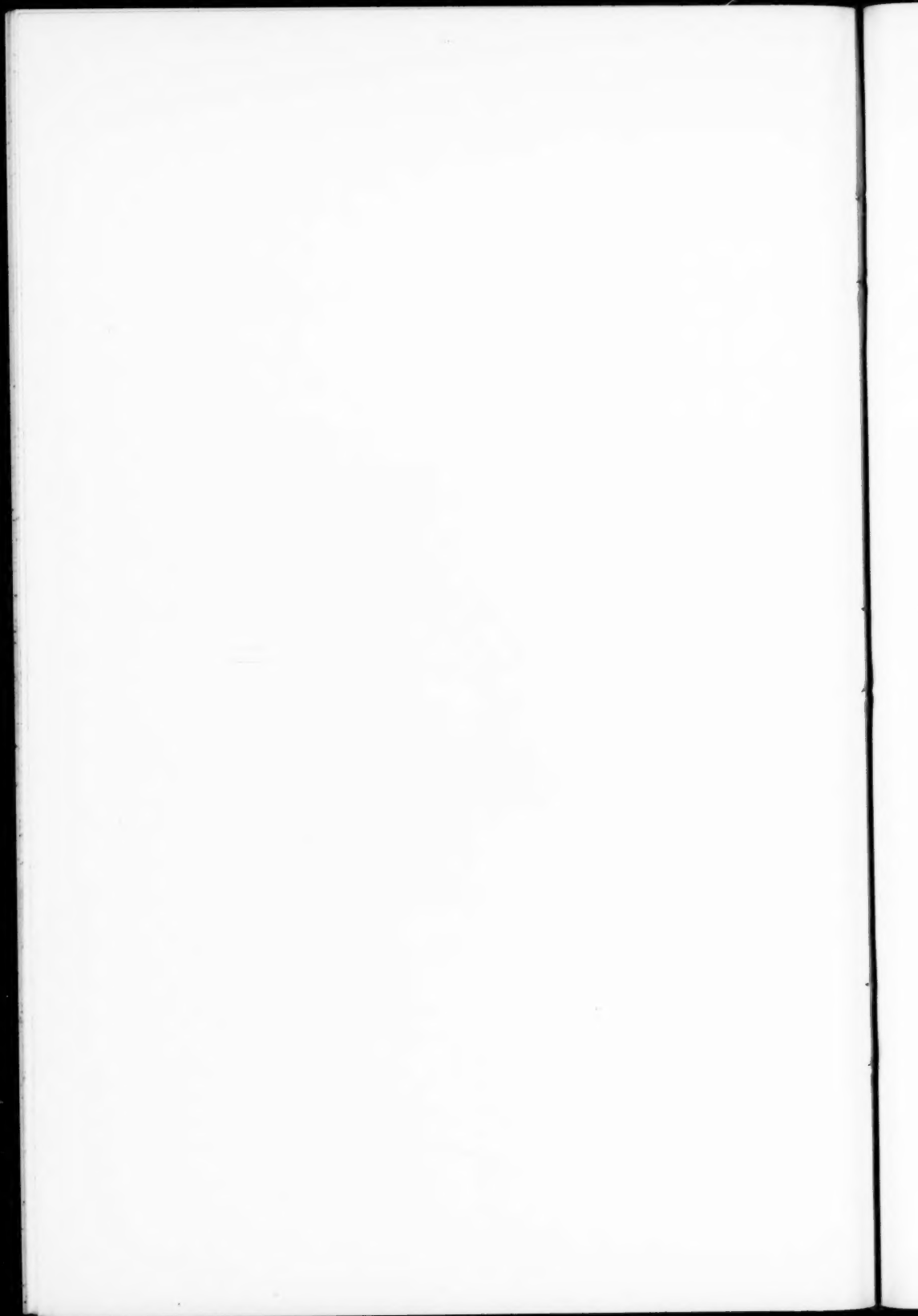




Fig. 3.

Base of nose, showing absence of scar following correction of saddle nose and tip depression with a celluloid implant by author's method. (See Fig. 8, Case 5.)

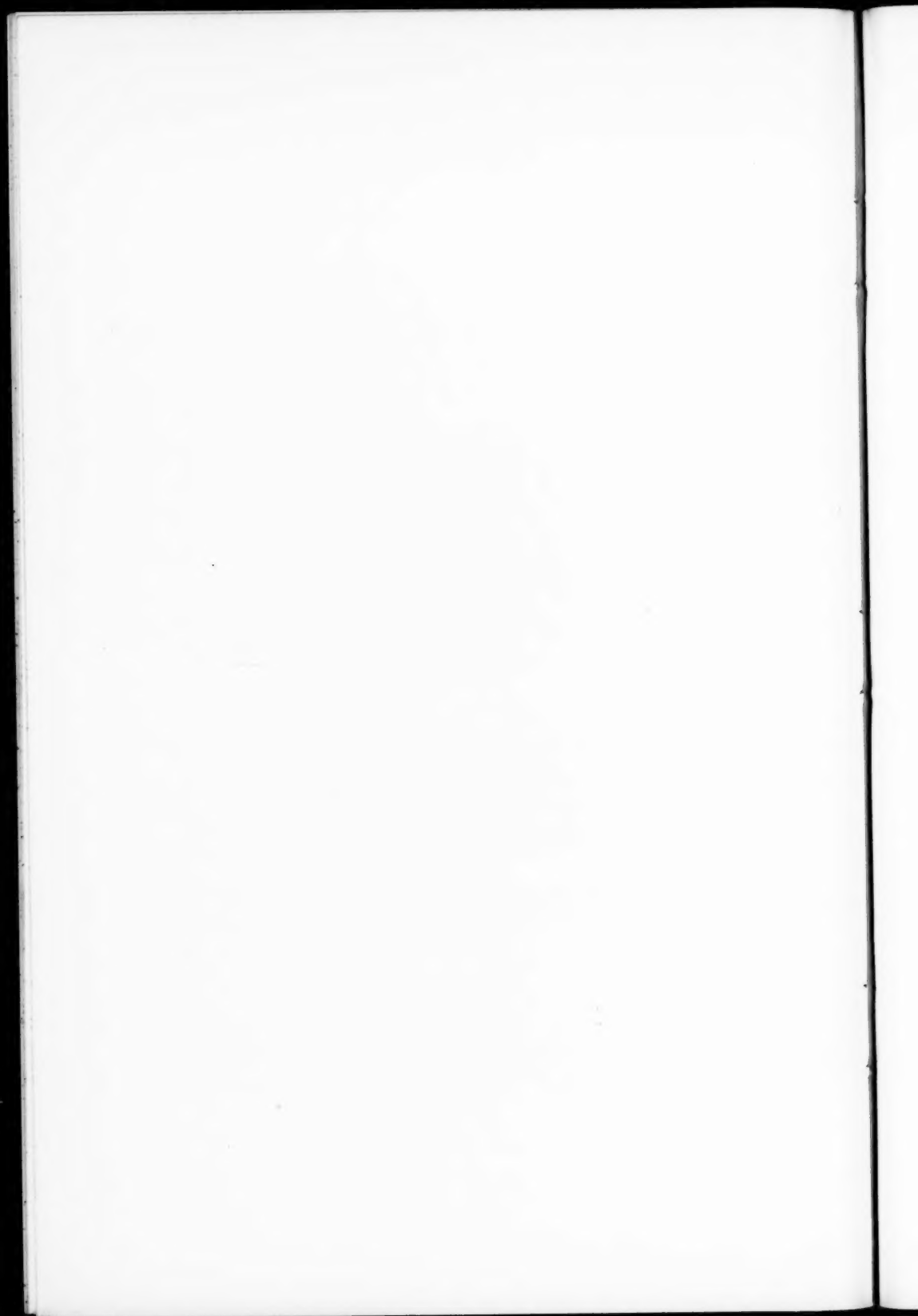


Fig. 4 (Case 1).



Preoperative Appearance.



Postoperative Appearance.

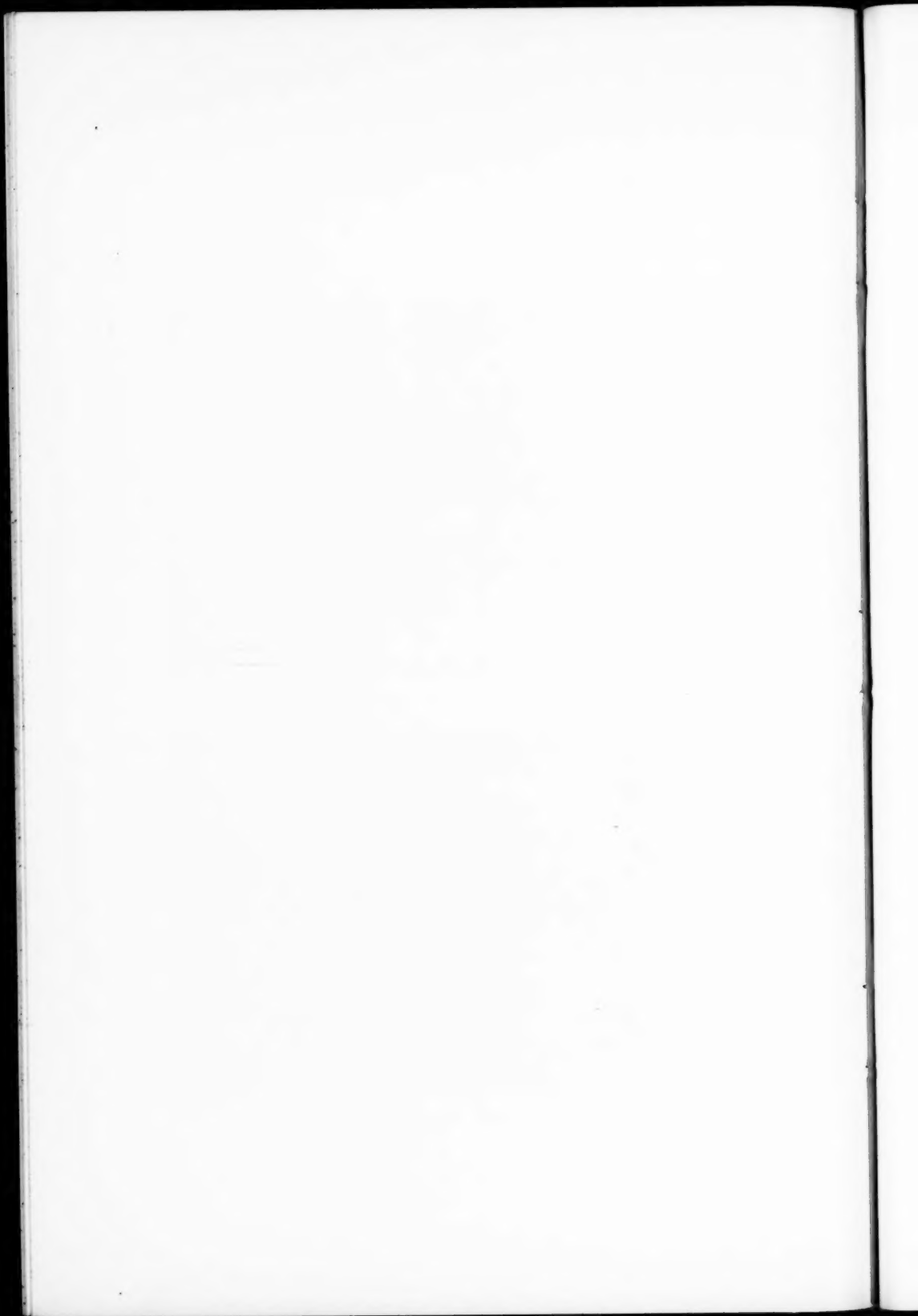


Fig. 5 (Case 2).



Preoperative Appearance.



Postoperative Appearance.

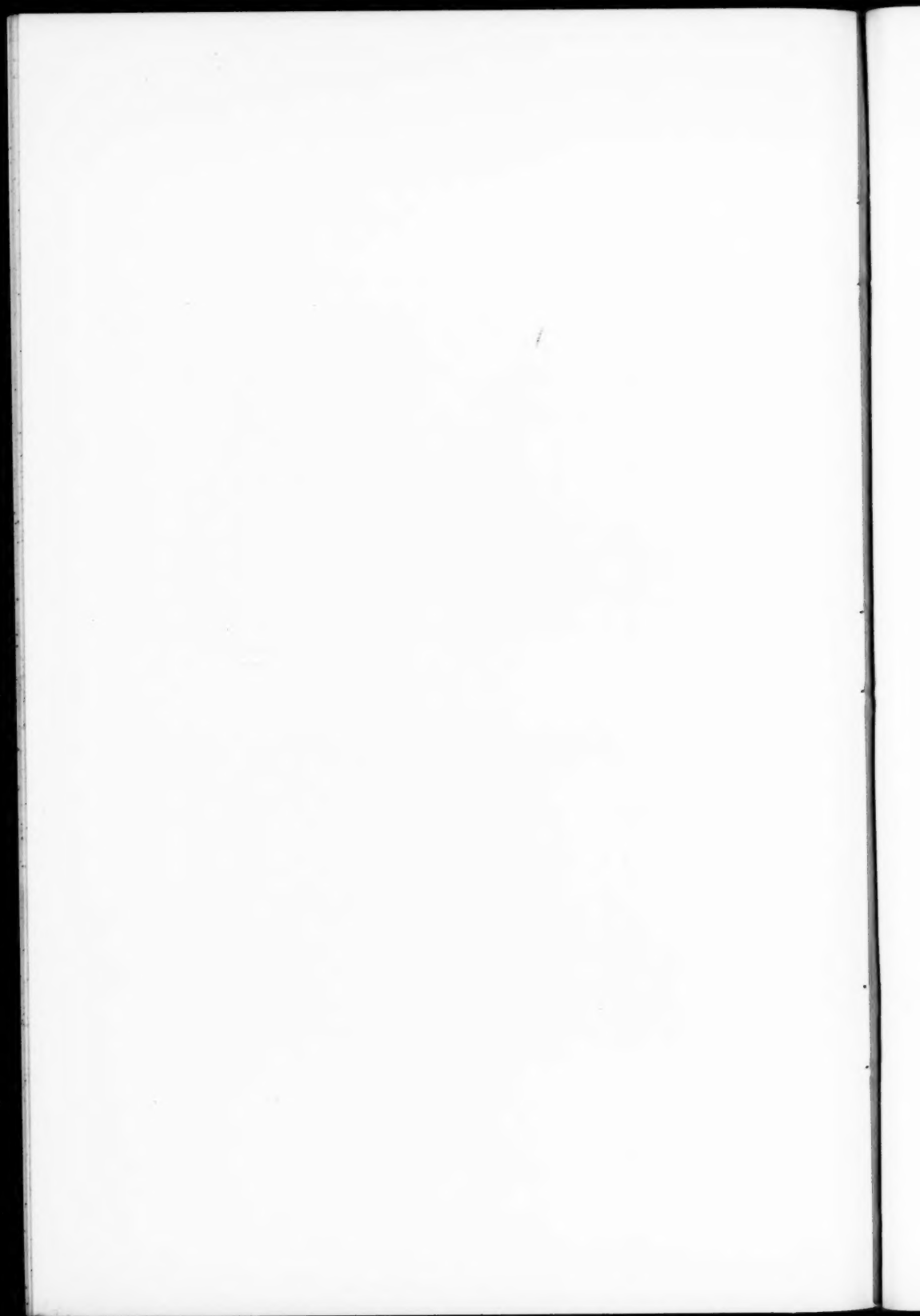


Fig. 6 (Case 3).



Preoperative Appearance.



Postoperative Appearance.

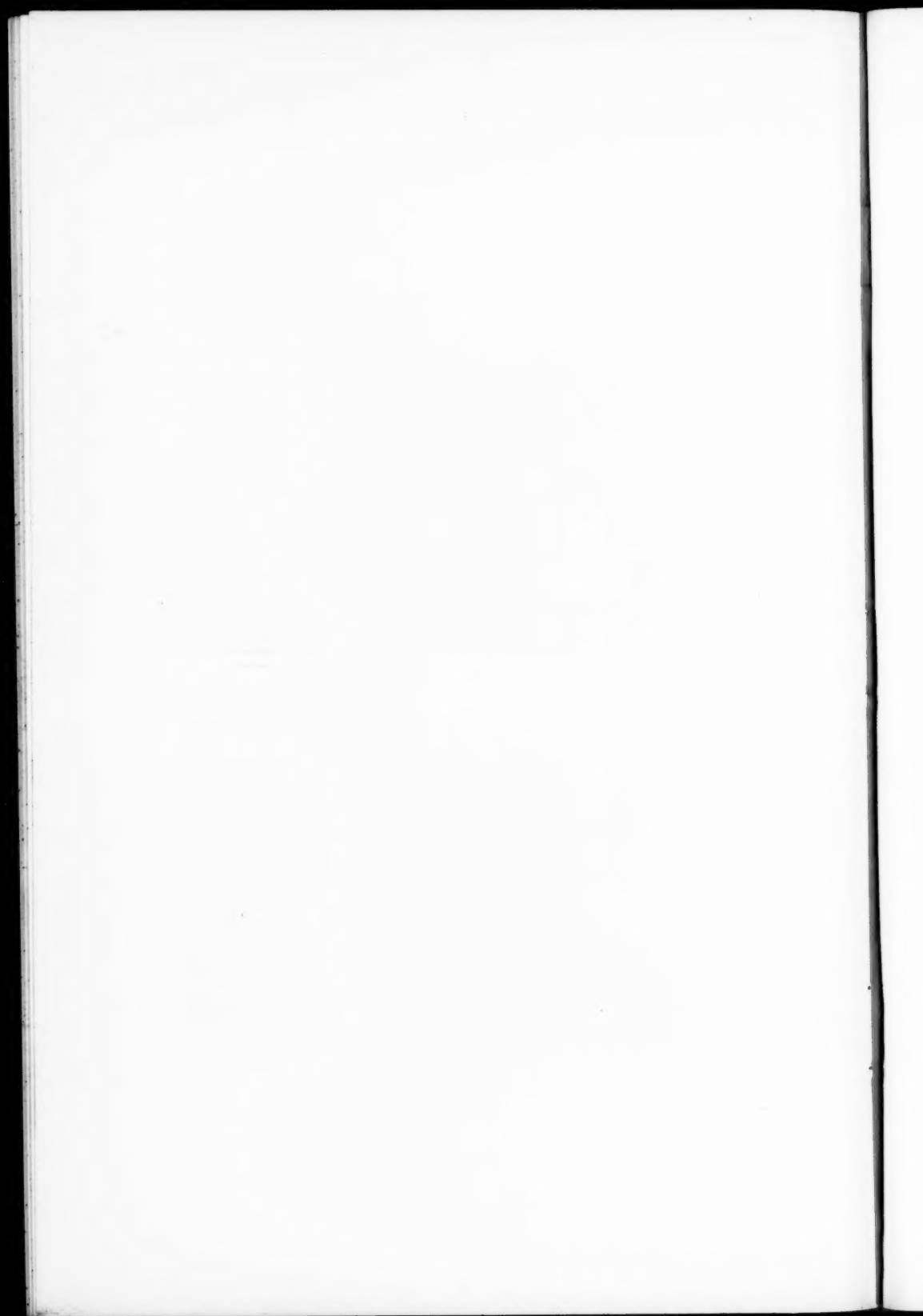


Fig. 7 (Case 4).



Preoperative Appearance.



Postoperative Appearance.

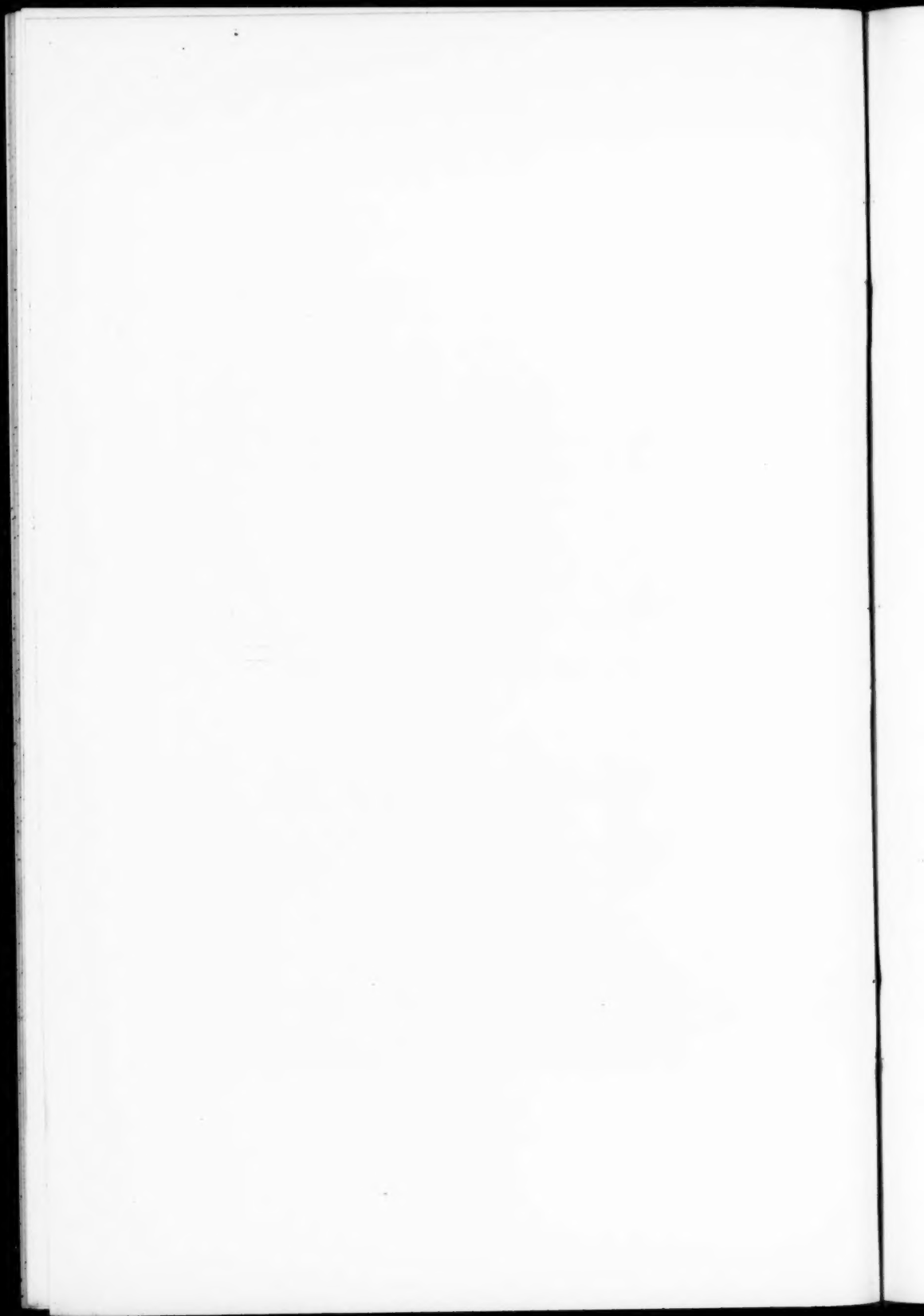


Fig. 8 (Case 5).



Preoperative Appearance.



Postoperative Result.

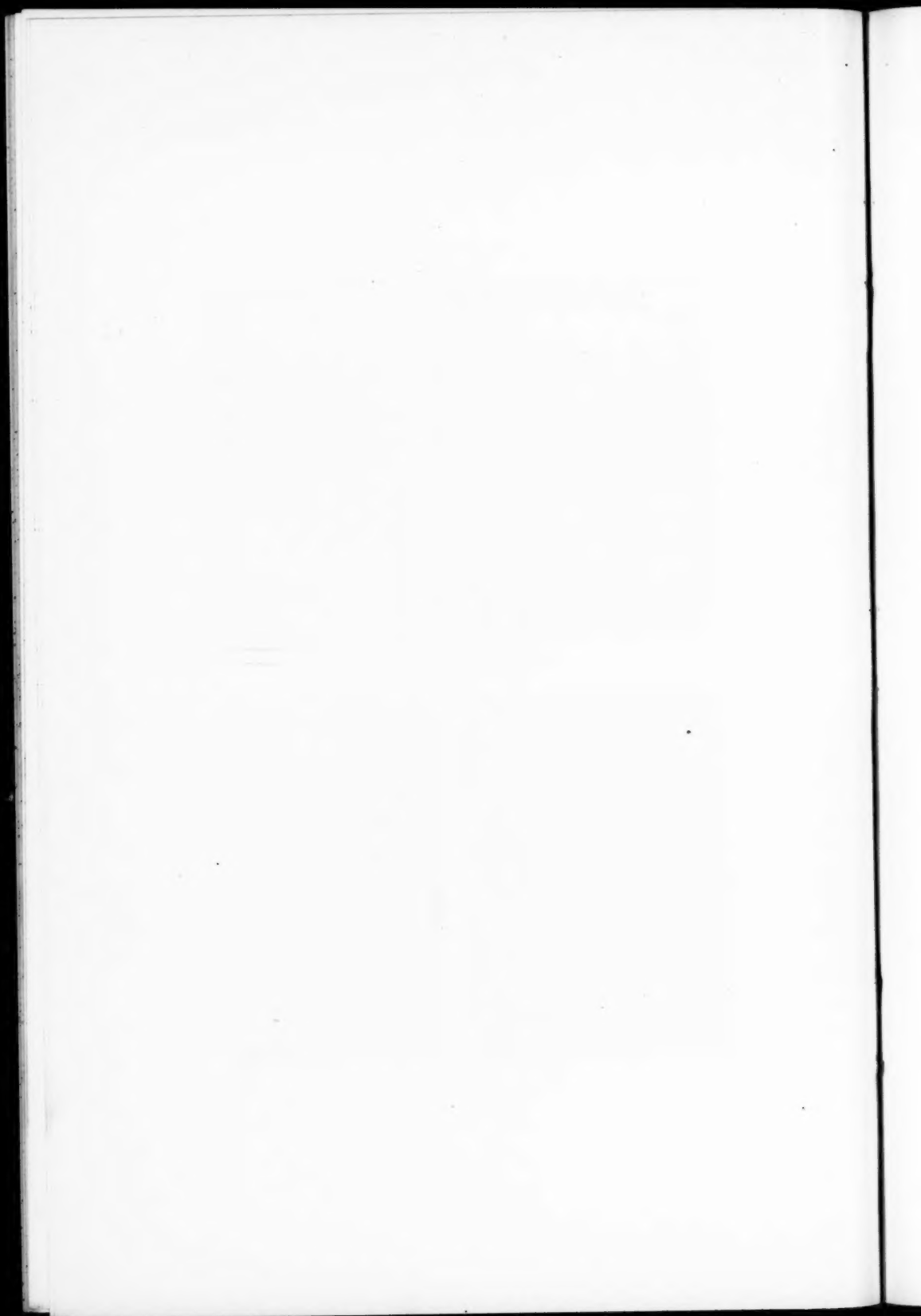


Fig. 9 (Case 6).



Preoperative Appearance.



Postoperative Result.

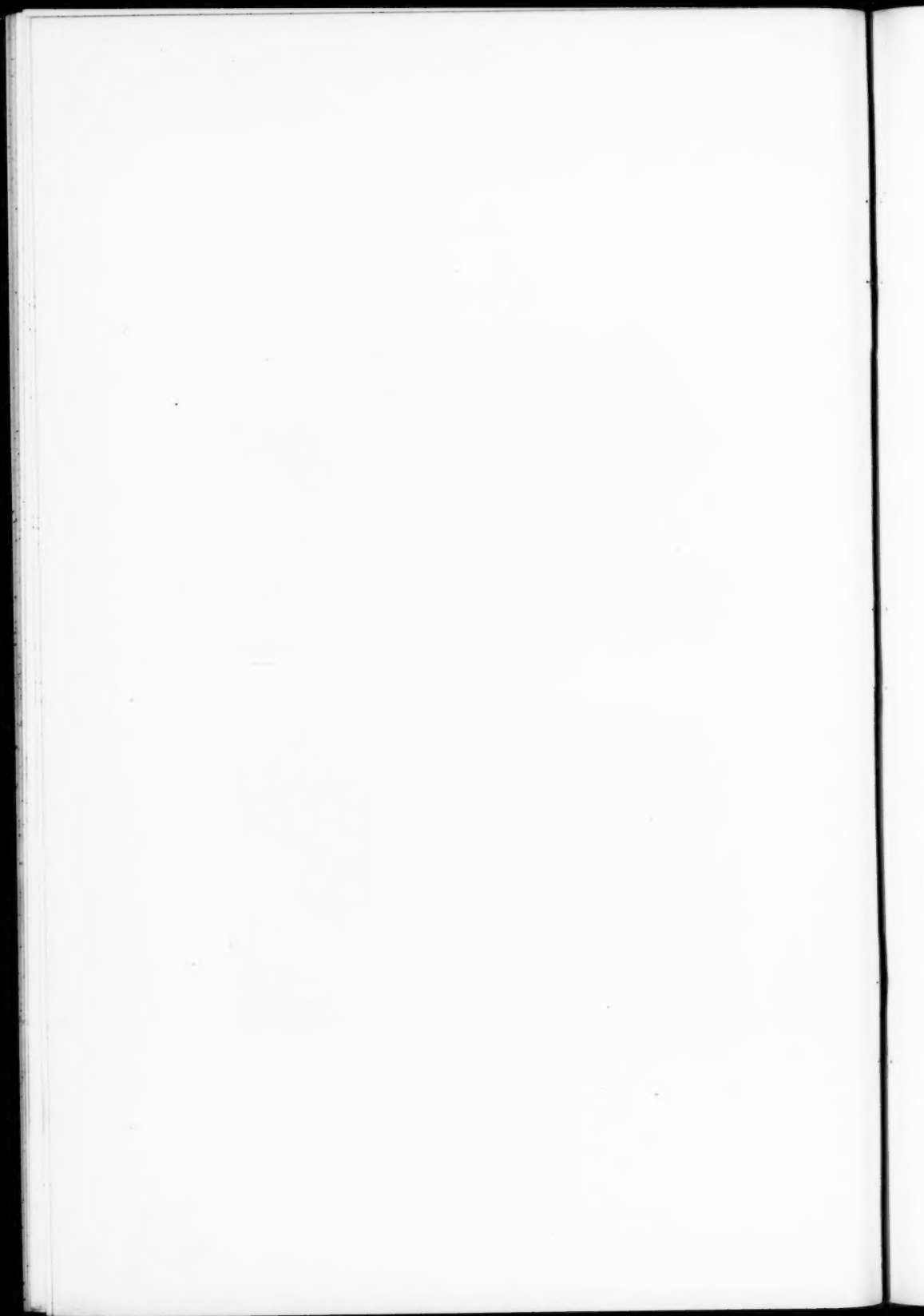


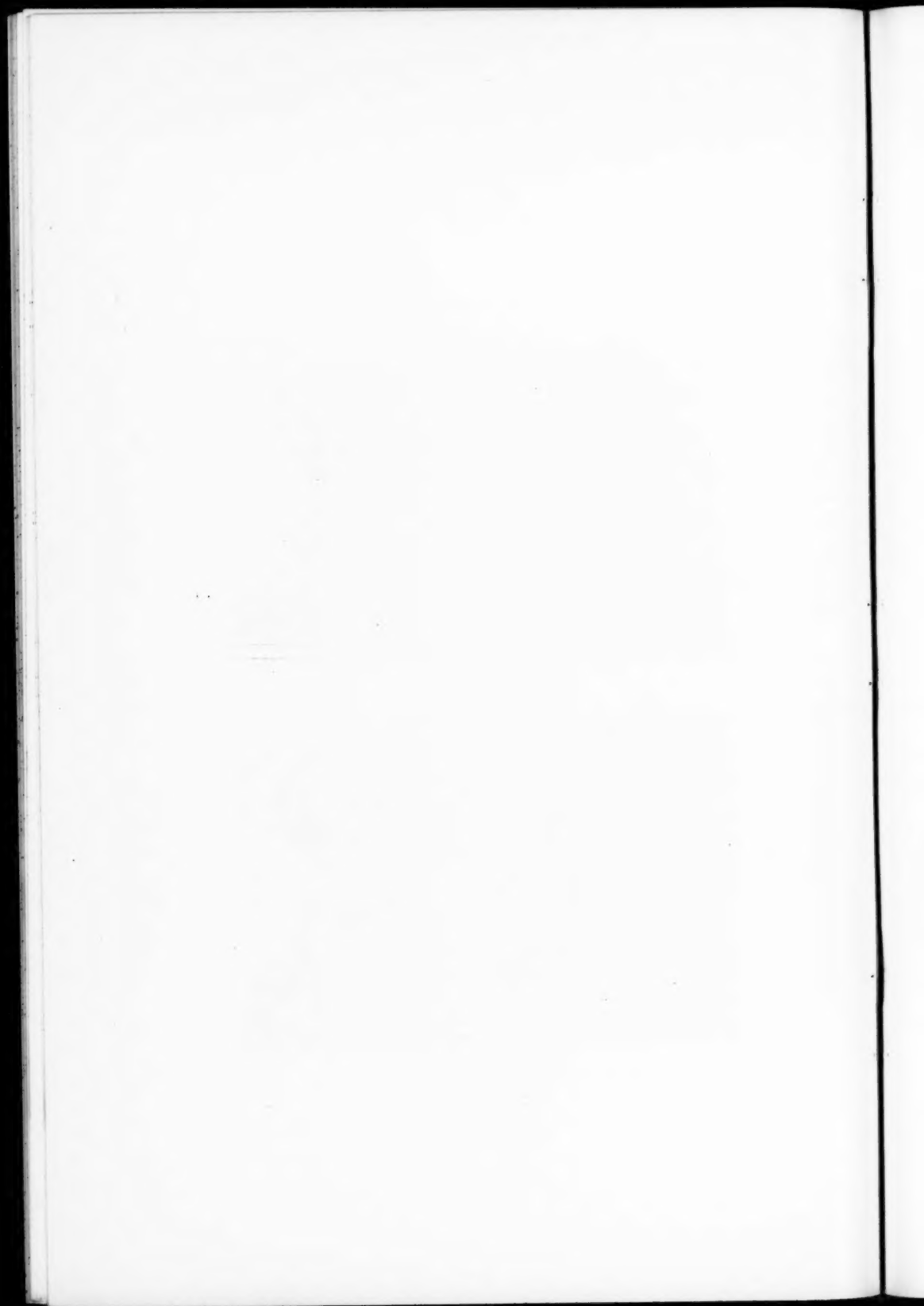
Fig. 10 (Case 7).



Preoperative Appearance.



Postoperative Result.





Skiagraph showing the two celluloid implants used in Case 7.

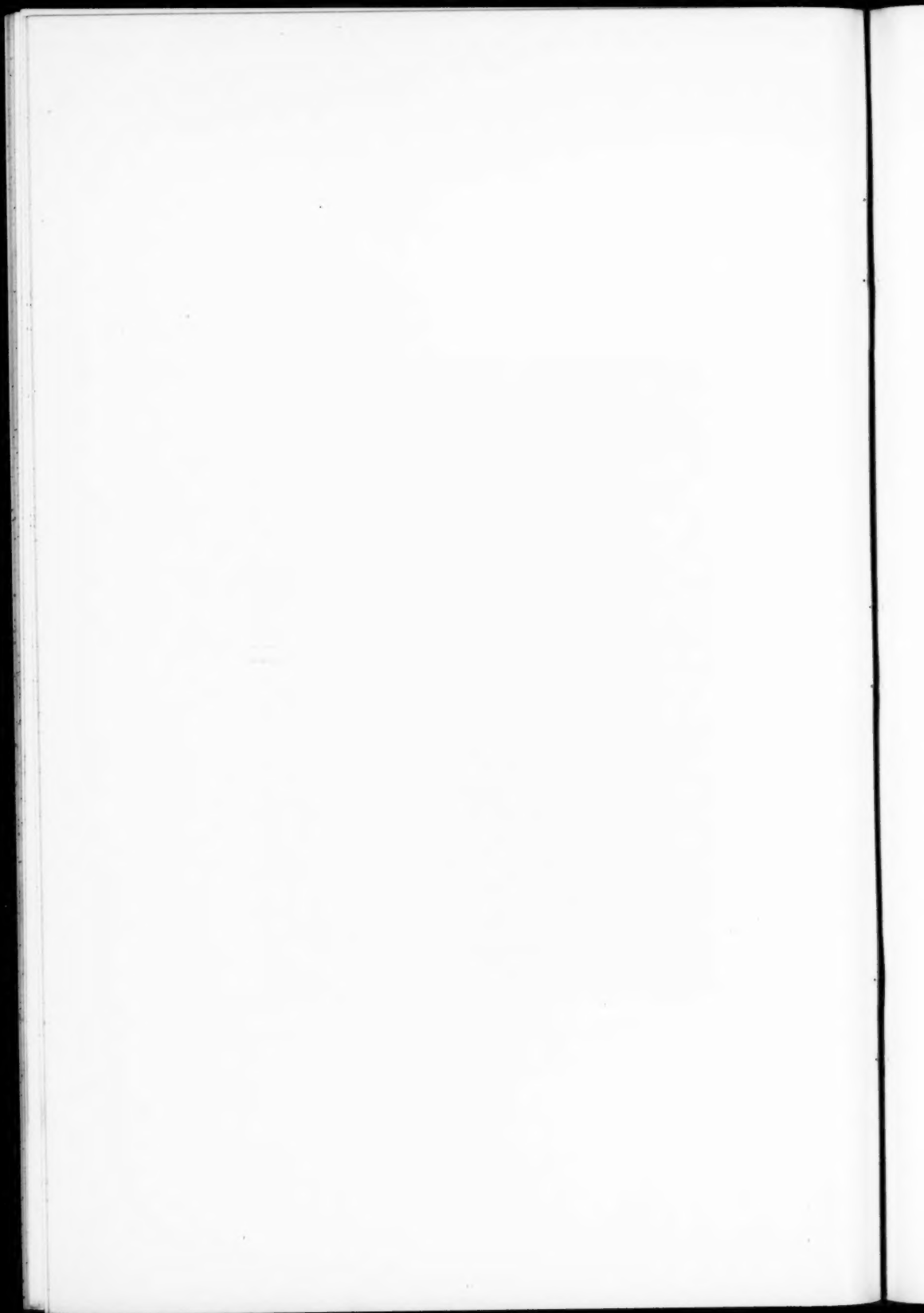


Fig. 11 (Case 8).



Preoperative Appearance.



Postoperative Result.

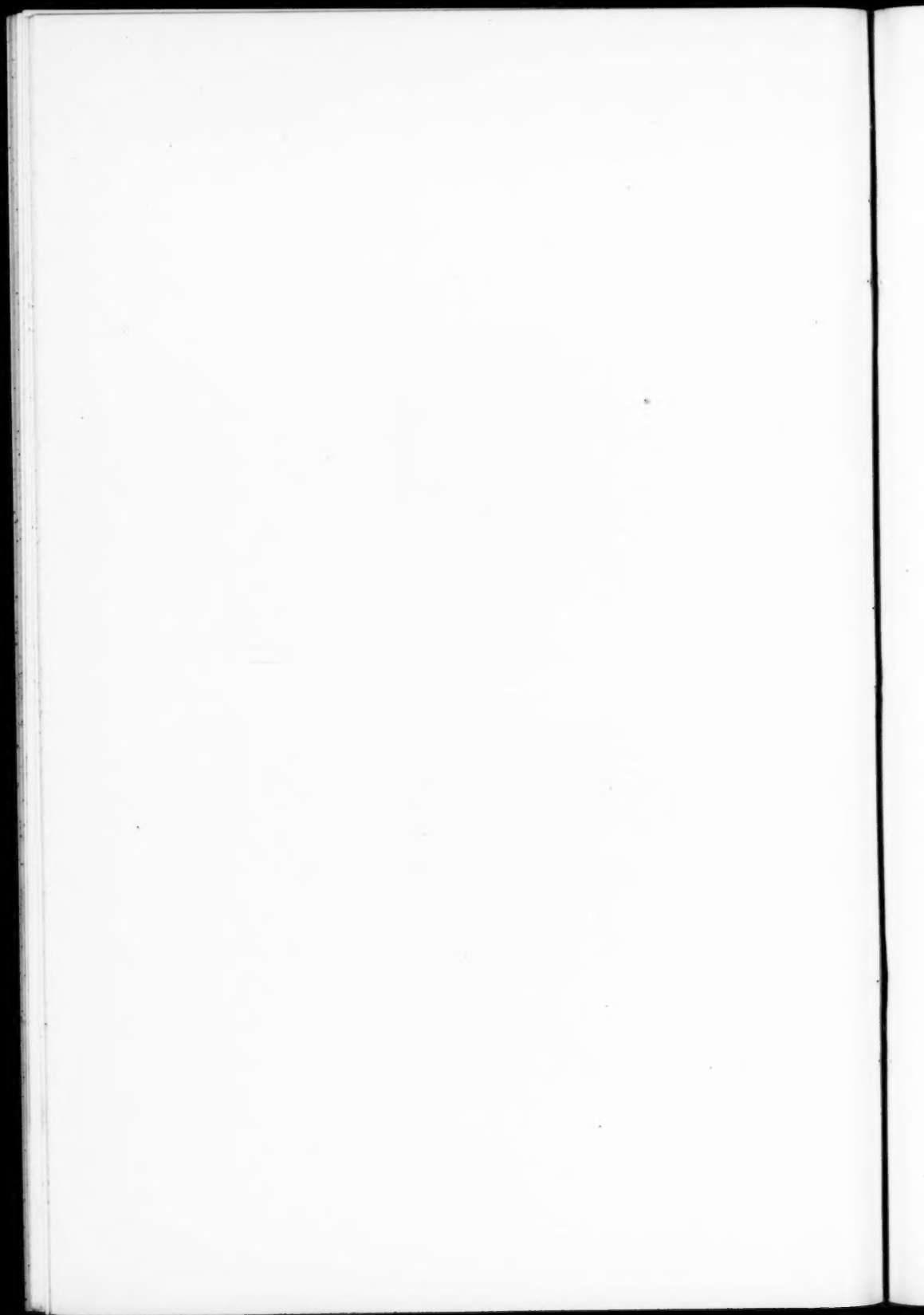


Fig. 12 (Case 9).



Preoperative Appearance.



Postoperative Result.

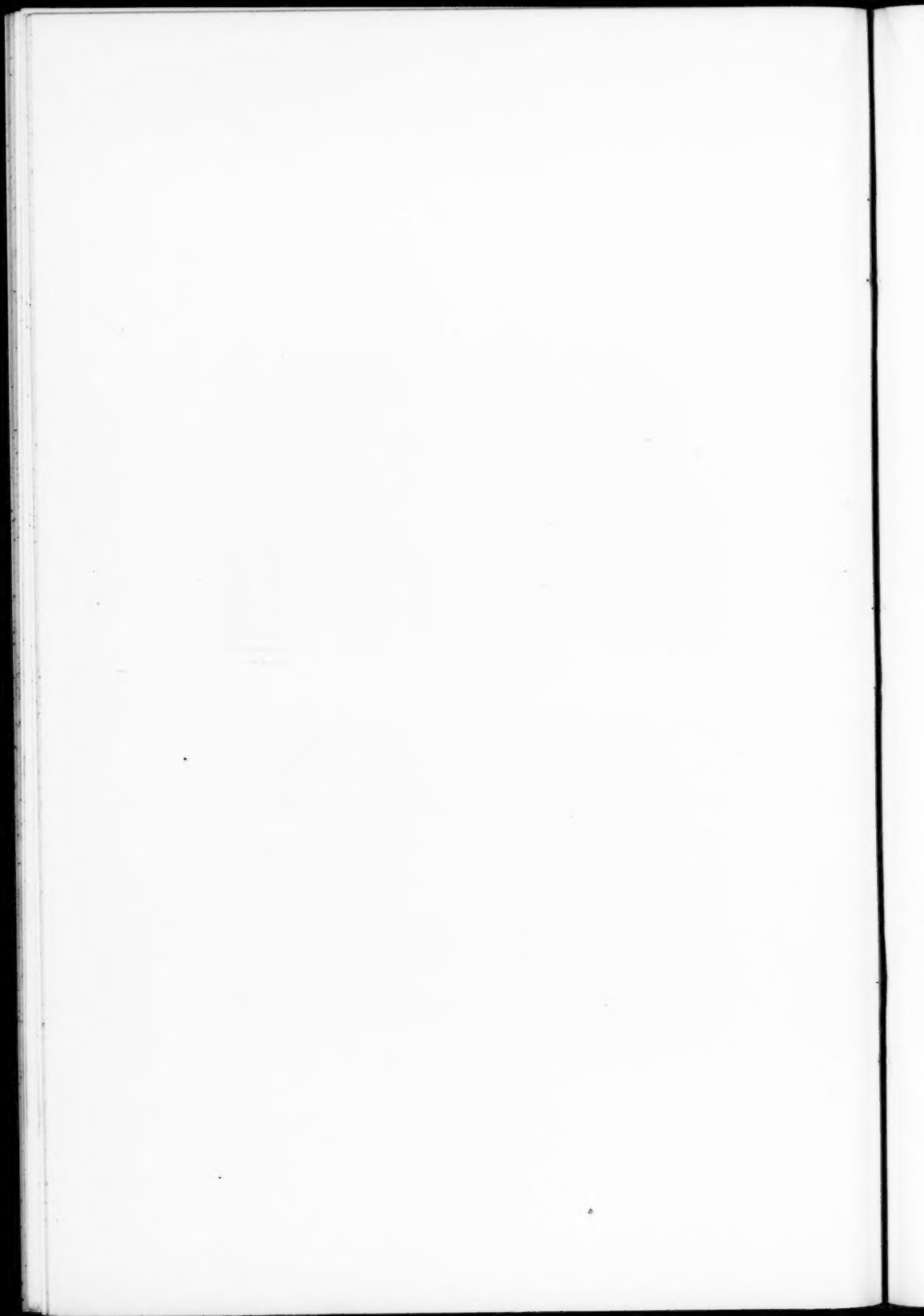
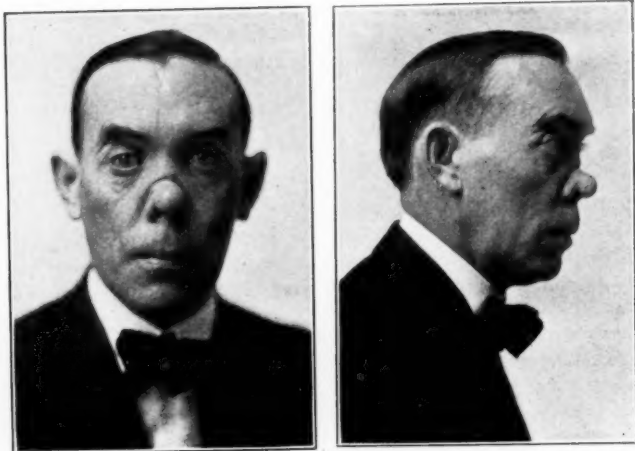


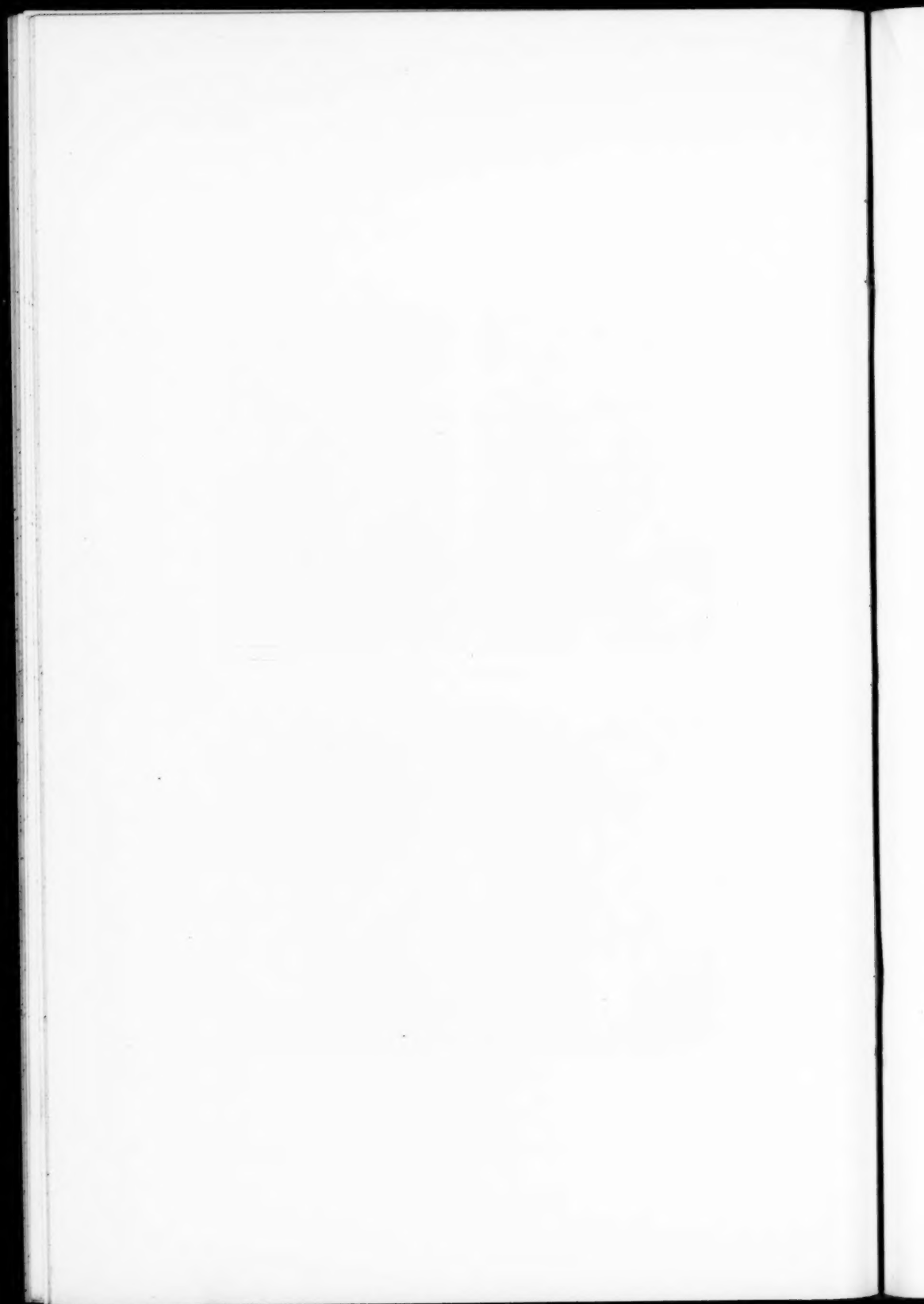
Fig. 13 (Case 10).



Preoperative Appearance.



Postoperative Result.



XXV.

THE RELATION BETWEEN THYROTOXICOSIS AND
TONSILLAR INFECTION.

By LOUIS E. BROWN, M. D.,

AKRON, OHIO.

Considering the amount of attention which has been directed toward infection originating in the tonsil, and also the extended study of disturbance of the thyroid function, it seems rather surprising that so little consideration has even been given to the possibility of relationship between the two. It would seem almost inevitable that whichever avenue of approach an investigator used, whether his interest were in the tonsillar condition or solely directed toward a consideration of thyroid pathology, he would sooner or later arrive at a point where the two lines of investigation would intersect. Yet a careful search of the literature reveals comparatively few instances of any such occurrence.

The writer's interest was first aroused to the possibility of some interrelationship between diseased tonsils and disordered thyroid in the routine course of otolaryngeal practice. The extensively reported experiments of Kimball and Marine upon the public school girls of Akron and other Ohio cities have recently called the attention of the medical profession all over the country to the fact that goiter is especially prevalent in this particular section of the United States. In common with the other medical men located here, the laryngologist sees many patients who present some degree of thyroid disturbance, the vast majority of these patients being adolescent girls or young women not many years past puberty. As the writer's interest was primarily in the indications of the tonsillar situation, and the goiter was considered only in the general survey of the patient's health and physical condition, it was some time before the conclusion was thrust upon him that there could be any definite connection between the two.

This is unfortunate in view of the present inquiry, for much valuable and interesting data were allowed to go unrecognized

and consequently unrecorded, which, if available at present, might be of great assistance in illuminating a rather obscure subject.

It was not until many patients—in the course of investigation of their general condition following tonsil enucleation—had reported decided improvement in the goiter itself, and an undoubted amelioration of its characteristic symptoms, that it became evident that these circumstances must be something more than casual coincidence. Nervousness had been greatly lessened and irritability was much less evident, pulse rate was markedly lower, and there had been a gratifying increase in weight. The thyroid enlargement in many cases had undoubtedly decreased, and the whole physical and mental condition was much benefited.

Confirmation of these observations came from another source—that relatively small class of patients who presented themselves for tonsil enucleation giving a history of previous thyroidectomy without any marked amelioration of the goiter symptoms. Relieved of their infected tonsils these patients reported a complete clearing up of all the thyrotoxic symptoms which had persisted after the thyroidectomy.

The repeated occurrence of these cases so impressed the writer with their significance that he resolved to extend his researches outside his own practice, and find out—if possible—whether other men working along the same general lines had had opportunities for making observations of similar character. With this purpose in view, he prepared a brief questionnaire covering those points on which he most desired additional information, and sent it to twenty-eight practitioners whom he believed to be so situated as to be able to supply the information he was seeking. Surgeons, internists, and ear, nose and throat men were represented in the list, the idea being to get as broad a range of opinion and as many different points of view as possible.

The response to the appeal was very gratifying. All the letters were answered, and although the majority modestly disclaimed possessing any information which they deemed valuable, the recipient of their kindness is compelled to differ with them. At the time the questionnaire was sent out the writer had found very little in the literature which had any bearing

upon his hypothesis, and although further search revealed a number of records and reports along these lines, the personal communications still remain of the highest value and interest.

Of the twenty-eight men to whom these inquiries were sent there were only six who felt unable to give any definite reply to the questions. Several of the remaining twenty-two were not in a position to give exact answers to the questions as arranged in order, but the general observations and conclusions they did give were very valuable and helpful. The results of the questionnaire may be summed up, using the different questions as headings:

1. How many cases of goiter have you had in your practice, in which, according to the patient's history, the symptoms accompanying the goiter were apparently temporarily increased during an attack of tonsillitis?

Thirteen replied positively that symptoms were always increased during an attack of tonsillitis, and but two had failed to observe any relationship between the two conditions. David Marine has often observed the phenomenon, but does not believe there is anything "specific in the reaction of these (goiter) cases to tonsil infection." Plummer of the Mayo Clinic is of the opinion that exophthalmic goiter "is sometimes aggravated by tonsillitis, while in other instances it is at least temporarily improved," this answer, however, having little if anything to do with the etiologic relationship of tonsillitis and exophthalmic goiter. Allen Graham calls attention to the fact that while tonsillitis undoubtedly aggravates both simple and exophthalmic goiter, these same phenomena have been observed in many other acute infections, "most notably tuberculosis."

2. In how many cases, where adults presented an early stage of goiter coincident with infected tonsils, was the growth of the goiter apparently arrested by the removal of the tonsils?

All the replies to this question might be classed as "affirmative." Comparatively few were able to state an exact number of cases, but the consensus of opinion was undoubtedly that the removal of infected tonsils has a beneficial effect on all types of goiter. Dr. Crile states that "in general, 50 per cent are apparently arrested by the removal of any infection, whether it be teeth, tonsils, sinuses, etc." Allen Graham says that

"it is unquestionably true that some patients who have both goiter and tonsillar infection are improved after tonsillectomy. This is strongly maintained by Dr. H. G. Sloan of this city (Cleveland, Ohio), who nevertheless recognized the importance of eradicating infection in the sinuses or any other focus as well as the tonsils."

Albert J. Ochsner has seen many goiters arrested after removal of the tonsils, but in all of these cases the patients were directed to follow a highly specialized diet and were especially cautioned to drink only boiled or distilled water. Dr. Ochsner would therefore appear to consider the dietary regime as more likely to have effected the improvement. David Marine thought that while few, if any, goiters were actually arrested, many were no doubt improved by the removal of any focus of infection, while O. P. Kimball had "seen two cases of well advanced exophthalmic goiter cleared up entirely on the removal of very bad tonsils, plus the simple treatment of saturating the thyroid gland with iodine." In this connection it is interesting to recall the statement of Marine and Kimball published last year,¹ that of more than 1,000 schoolgirls who took iodine prophylaxis for a period of three years, only five showed an increase in the size of the goiter at the end of the period, and four of these five had enlarged and infected tonsils.

3. How many cases, after a thyroidectomy, in which the symptoms persisted, were relieved by a tonsillectomy?

A wide divergence of opinion was revealed by the answers to this question. Mithoefer of Cincinnati had never observed any such cases, while T. E. Carmody (whose figures are only approximate) had seen two: J. M. Ingersoll of Cleveland estimated the number at about 10 per cent of thyroidectomies, and James J. King of New York had an "impression" that one or two who were not relieved by thyroidectomy were relieved by a subsequent tonsillectomy. While Crile was unable to give exact figures, he attributes the persistence of goiter symptoms after thyroidectomy to one of two factors: "1. Not sufficient thyroid removed. 2. Focus of infection has been overlooked." This is interpreted by the writer to mean that if the focus of infection were in the tonsils the goiter symptoms would continue so long as the tonsil remained unextirpated. J. A. Stucky of Lexington, Ky., on July 9, 1921, had

seen seven cases still under observation where the usual symptoms persisted after thyroidectomy, but "were relieved promptly by tonsillectomy." It is likely that Dr. Stucky may later be able to throw more light on this particular question. Several others had no data of any sort on which to base a reply to this question.

4. How many cases of young girls at puberty, who have a beginning simple goiter, had their tonsils removed in early childhood, or at least before the symptoms of goiter were evident?

The most of those questioned "fell down" on this section. "No data" was the reply of the majority. Dr. C. W. M. Poynter of the University of Nebraska considered it "particularly significant." He believes that "as long as we do not know what makes the tonsil susceptible to infection we should begin by assuming that 'lowered resistance' due to goiter acts, not in a specific way, but as any other devitalizing influence, as bad hygiene, etc." Wallace Irving Terry of San Francisco thinks "it will be interesting to learn in a few years whether goiter with exophthalmus is less prevalent in young women who have had their tonsils removed in early life."

5. In those who have not had the tonsils removed, how many were benefited or cured by a tonsillectomy?

All who answered this question seemed to hold the opinion that in adolescent girls who were developing goiter the removal of infected tonsils invariably had a beneficial effect on the thyroid condition. Dr. Crile says, "We feel that only very frank exophthalmic goiter patients are not cured by removal of focus of infection unless they also have thyroidectomy performed."

6. Have you ever had a goiter case that also had infected tonsils, where, after a thyroidectomy had been done, the patient had no further tonsillar trouble?

The only affirmative answer to this question was that of H. S. Plummer of the Mayo Clinic. All the rest answered no, without any qualifications. The unanimity was decidedly striking.

7. What per cent of goiters, in your opinion, are of toxic origin?

This question was evidently somewhat vague, and consequently those who attempted to answer it found considerable difficulty in making their replies satisfactory to themselves. Charles H. Major judged that about 40 per cent of the cases coming to his clinic are toxic. Allen Graham objected to the term "toxic goiter" as indefinite and "subject to various interpretations." In common with Ochsner, he feels that "the region from which the patient comes" is the most potent factor in the nature of the thyroid disturbance. The other replies estimated the number of toxic cases all the way from 50 per cent to "practically all." Marine thinks "relatively few exophthalmic goiters are of bacterial toxic origin."

Many of those questioned made valuable contributions to the discussion, which were not directly included under the questionnaire. There is evidently a strong feeling that treatment, especially the iodine therapy so successfully administered by Marine and Kimball, or the special diet and regimen as advocated by Ochsner, have a much greater part in effecting cure or amelioration than the removal of infection, in the tonsils or any other location. Terry believes that "focal infections play a considerable part in activating a hyperplastic thyroid, but unfortunately removal of foci of infection is not followed by many cured of the goiter." Marine regards "most of the (goiter) cases as types of exhaustion as, for example, those following fright and prolonged worry," all acting "on the same mechanism within the body." He believes "the suprarenal gland plays a very important role in this syndrome, and it has long been known that this gland likewise plays an important role in infections." He adds that "one must bear in mind that the thyroid hyperplasia in goiter is accompanied by lymphoid hyperplasia irrespective of clinical associations," and this causes him to "seriously doubt that any cause and effect relation between lymphoid hyperplasia and thyroid states will be established."

Dr. Poynter sees nothing in the juxtaposition of the tonsils and thyroid to warrant us in assuming a connection between them, either through lymph or blood channels. He thinks that if any relation exists it will be found to be through internal secretion, but adds that "a very large percentage of hyper-

trophied tonsils in conjunction with enlarged thyroid might be significant."

Emil Mayer wrote that, while he was unable to give any exact figures, his experience led him to believe that "an early operation on the tonsils would have a very beneficial effect upon the (goiter) patient, retarding the growth, or even entirely preventing the further advance of a goiter that often is of toxic origin."

A careful examination of the replies as a whole would seem to lead one to the conclusion that most of these men have given little consideration to the possibility of an interrelation between infected tonsils and thyrotoxicosis. The consensus of opinion may perhaps be pretty fairly summed up in the words of Allen Graham, who wrote:

"Regarding exophthalmic goiter, in the vast majority of cases, neither on history nor physical examination can the tonsils be incriminated as the chief etiologic agent, nor the factor that prolongs the syndrome, even granting that it (tonsillitis) might aggravate the symptoms when it occurs. On the other hand, a considerable number of patients date the onset of their trouble from a systemic infection, not necessarily of tonsillar origin. Also a large number of cases develop in which the infection plays little or no part, so far as can be determined by history and examination."

The function of the normal tonsil is not fully known, indeed there is relatively firm ground under the feet of those who maintain that there is no such thing as a normal tonsil, inasmuch as practically each one removed can be proved to be more or less pathologic. Anyone who has investigated the anatomy of the tonsils will immediately perceive how liable they must be to infection with all kinds of bacteria. The tonsils occupy an "open" position in the throat—that is, no food or air can find its way to the stomach or lungs without first passing these tissues. Moreover, deglutition opens up the tonsillar fossæ in such a way that the mouth secretions continually come in contact with them. We know that the tonsil encloses a number of deep crypts lined with highly sensitive epithelium. A cross section of the tonsil mass will disclose how these fossæ with their covering of columnar epithelium reach far down, sometimes to the very root of the tonsil itself.

Not infrequently one crypt communicates with others, and their delicate lining epithelium is directly in contact with the tonsil parenchyma, the chief constituent of which is mononuclear cells. Thus a great extent of absorbent surface is always open to infection, and in addition to this the opening of a fossa is apt to become clogged during the progress of any inflammatory process, so that the infectious material which the crypt contains is sealed up within it. When we consider that the tonsil does not secrete and has no avenue of elimination except through the mouth of the fossae, we can readily comprehend how this infective material must of necessity be gradually absorbed into the system.² Many years ago George B. Wood³ demonstrated that bacteria will generate toxin in the crypts and that if this bacteria is virulent its first point of attack will be the cryptal epithelium. In the large majority of cases they gain access to the tonsillar parenchyma only after their toxins have destroyed the epithelium. When the bacteria have gained access to the tonsillar tissue, they find permanent lodgment only in the germinating follicles. The current in the interfollicular tissue tends to carry the bacteria toward the efferent lymphatics. Thus a definite lymphatic connection may be established with many other parts of the organism.

During the war period the energies of the medical profession were so completely absorbed by the pressing problems of the battle area and evacuation hospital that all mere academic inquiries were laid aside and forgotten. To find anything bearing on a possible relation between thyroid and tonsillar infection it is necessary to search the literature which appeared before the world convulsion of 1914.

Up to the end of the nineteenth century the thyroid had received little attention as a possible factor in systemic disease. Its connection with simple and exophthalmic goiter, with myxedema and cretinism, was fairly well understood, but there had been comparatively few studies made of these conditions outside the regions where goiter was endemic. During the closing years of the century Roger and Garnier⁴ published in *La Presse Medicale* and the *Transactions of the Societe de Biologie* a series of papers on the thyroid gland, one of which dealt especially with the reactions of the gland to general infections, and the pathologic changes taking place at such a

time. Thirty-three postmortem examinations were made, the material being taken from patients dying of such diseases as diphtheria, scarlet fever, cerebrospinal meningitis, smallpox and purulent staphylococcic peritonitis. These authors reported that the condition of the thyroid was about the same under all conditions; that neither the specific character of the infection nor its virulence and duration seemed to make much difference in the condition of the gland under examination. Most of the lesions were characteristic throughout. The glandular hypersecretion appeared less abundant in the diphtheria cases than in those of scarlet fever, but the diphtheria thyroids contained a greater number of desquamated cells and the colloid material was more frequently altered. In one diphtheria case a parenchymatous hemorrhagic area was found in the thyroid.

These authors performed a number of experiments upon rabbits and guinea pigs, finding it an easy matter to infect the thyroids of these animals by injecting a culture into the center of the carotid artery, which had been previously ligated below the junction of the thyroid artery. The infection thus set up was practically identical with that observed in human subjects, although much more acute, and so brief in duration as to give little or no time for organic reactions to be established.

The conclusions drawn by these authors were that during the course of acute infections disturbances of secretion more or less profound occurred in the thyroid, "as in the other glands of the economy." After a period of hyperactivity, a period of diminution will follow or an alteration of function. Just as the liver at such times will secrete abnormal pigments, the thyroid will form colloidal material, atypical and peculiar to these conditions.

Roger and Garnier's investigations apparently attracted little attention in this country, and it was not until Billings, Rosenow and their coworkers began to publish the results of their researches on focal infection that the possible relation of the thyroid to systemic disturbances was brought to general notice in the United States. In his address on focal infection delivered before the American Medical Association in 1914 Frank Billings⁵ reported three cases of rheumatism attended by acute tonsillitis and thyroiditis, attributing all three mani-

festations to a single focal cause. He went on to say that the interest of his clinic was aroused to the possibility of focal infection as a cause of goiter. He reported seven additional cases which "seemed to show that there is an infectious type of goiter with and without symptoms of exophthalmic goiter, which seems to be of toxic origin. The rapid subsidence of the goiter and the symptoms after the removal of the foci of infection in the jaws and tonsils was a surprise." All of these patients gave a history of chronic tonsillitis. Dr. Billings ended by saying that to the list of acute conditions already known to be due chiefly to focal infection we were now justified in adding several others, including "certain infectious types of thyroiditis, with or without hyperthyroidism."

A year before Dr. Billings' address was made Clement F. Theisen⁶ of Albany, New York, published some causes of acute tonsillitis complicated by an acute thyroiditis. These cases offer perhaps the best support which the present writer has been able to find in the literature of a close interrelation between infections of the tonsil and the thyroid. Theisen believed his cases to be "of particular interest from an etiologic standpoint, as in all except one case the inflammation of the thyroid gland occurred with or directly after attacks of tonsillitis. Two of these patients have each had two distinct attacks of acute thyroiditis, each time with an acute tonsillitis, and both have since developed well marked diffuse goiters." While Theisen does not wish to be understood as emphasizing the foregoing facts as important etiologic factors in the development of goiter, he feels that it is by no means impossible that the repeated inflammatory attacks to which the gland was subjected may have, partly at least, been responsible for the subsequent chronic hypertrophy of the thyroid gland.

All of Theisen's patients were young women. Briefly summarized, the cases were as follows:

Case 1: Age 20. Sore throat for several days before examination revealed a typical follicular tonsillitis. Thyroid enlarged and tender on palpation, the hypertrophy increasing during the course of the tonsillitis. The swelling of the thyroid had begun during the third day of "sore throat," and the patient stated that the gland was not enlarged before the attack of tonsillitis. Under the usual treatment for tonsillitis,

with an ice coil about the neck, the attack subsided in about a week. Tonsillectomy was refused, and the next winter the patient again presented herself with a similar attack, "running the same course and again developing with an acute tonsillitis. This patient came to the clinic at regular intervals during the next two years, and while there were no further attacks of acute thyroiditis, she developed a gradually increasing diffuse goiter. It is at least possible that etiologically there is a connection between her attacks of thyroiditis and the subsequent hypertrophy of the gland. There is no doubt that the infection of the gland was each time caused by the acute tonsillitis."

Case 2: Age 22. Same history as preceding case. Patient was practically well in ten days and was not seen again for about two months, when she came to the clinic with typical symptoms of hyperthyroidism.

Cases 3 and 4: 21 and 24 years old. Both stated that before the present attack they had no enlargement of the thyroid. One patient was just getting over a severe attack of acute tonsillitis, and the other was still having an acute attack (no mention of sequelae of hyperthyroidism in these cases).

Case 6: Age 19. Very severe acute tonsillitis, which was followed by the development of acute thyroiditis. The attack ran the usual course and a year later another acute thyroiditis came on with an acute follicular tonsillitis. This patient has been under observation continuously and has developed a well-marked diffuse goiter, which started about six months after her last attack of thyroiditis.

Case 7: Age 30. A very severe acute thyroiditis came on directly after an acute tonsillitis. "There was a good deal of dyspnea and dysphagia in this case, and within a few months after the attack she developed a typical condition of hyperthyroidism."

In concluding this report Theisen remarks that he found very few cases recorded in the literature where acute thyroiditis occurred in conjunction with tonsillitis. A study of his case histories naturally suggests the possibility of overlooking the occurrence of thyroid involvement in acute tonsillitis. It seems reasonable to suppose that recurring attacks of tonsillitis might involve the thyroid and eventually set up a chronic con-

dition of hyperthyroidism, even if the thyroid symptoms were never sufficiently acute to be differentiated during the tonsillitis attacks.

Seven years ago Shurley⁷ stated that his attention was called to the relation of the tonsils to thyroid disease "by the beneficial results of a series of tonsillectomies for the relief of recurrent tonsillitis and quinsy, attended by incipient typical and atypical Graves' disease. The prompt, permanent and prophylactic value of enucleation in this class of cases adds another definite indication to surgical procedure which is given no attention in the literature. As acute and chronic tonsillitis and peritonsillar abscess are recognized as important etiologic factors in incipient exophthalmic goiter, tonsillectomy may then be classified as a prophylactic measure in our new and fashionable department of preventive laryngology."

The discussion which followed Dr. Shurley's paper brought out some interesting data on the relation of tonsil infection to thyroid disturbance. Greenfield Sluder of St. Louis stated that while the clinical relationship between the lymphoid ring and the thyroid gland was not clear in the minds of anatomists, it is an established fact that the lingual tonsil develops from the same branchial arch, and in early fetal life there exists the thyroglossal duct, which is closed early. It is sometimes found in the dissecting room, but the speaker has never been able to observe it in a living subject. He had observed marked improvement in goiters where all treatment had been directed toward the lingual tonsil.

Dr. George B. Wood of Philadelphia reported the case of a trained nurse who had recurring tonsillitis, followed by exophthalmic goiter and hyperthyroidism. After removal of the tonsils the attacks stopped for six months, the goiter began to go down and the exophthalmos to disappear. Then followed a slight sore throat with a less severe attack of hyperthyroidism, and examination now revealed that the faucial tonsils had not been entirely removed, a small piece still persisting in the upper part of the tonsillar recess. When this was removed all symptoms of hyperthyroidism permanently disappeared.

Dr. Woods' explanation of this case was not by a direct relationship between the lymphoid ring and the thyroid gland,

but rather by the presence of an infective process originating in the ring which upset the metabolism of the body so as to produce goiter and hyperthyroidism.

Shambaugh of Chicago was of the opinion that the phenomena of thyroid disease suggested very strongly a condition caused by some focus of infection, as around the teeth, or latent in the faucial tonsils. This latter condition is often overlooked. When the systemic condition develops in connection with a severe attack of acute tonsillitis, the tonsils are often suspected of being the focus, but if the infection is latent and the patient does not complain of throat symptoms, the examiner may not think of the tonsils at all. Chronic tonsillar abscesses are frequently discovered in patients who give no history of "sore throat," and such abscesses are often unrecognized before the tonsils are extirpated.

Evans and his collaborators⁸ made extensive observations on students entering the University of Wisconsin during the five years 1910 to 1914, inclusive. Wisconsin, being situated in the so-called "goiter belt," offers an excellent field for research on the subject here discussed. The tabulated results of these researches "afforded decided evidence of the actuality of a connection between nasal and throat affections and the large occurrence of thyroid involvement." The recognition of the tonsils as a site of parasitism by *endameba gingivalis* (Gros) in the laboratories of the Universities of Pennsylvania and Wisconsin raised the question of a possible connection of this organism with the thyroid enlargements "because of the evidence obtained of its part in the etiology of other conditions, for example, pyorrhea."

The authors emphasize the fact that in suggesting endamebiasis of the upper respiratory tract as possible causes of thyroid hyperplasia they are not advancing these protozoa as the specific producers of the toxins effective in producing the hyperplasia. If this were true, there is no reason why everyone who is the host of these parasites (a high proportion of all adults) should not also be the subject of thyroid enlargement. Their belief is that the essential toxic factors are really the products of the bacteria associated with the amebæ, and that these bacteria are the variants and the amebæ the con-

stants in many different infections of the mouth, tonsils and so forth.

Acting upon this hypothesis they selected forty-one cases of cryptic tonsillitis with thyroid involvement for special study and treatment by emetin hydrochlorid. Their conclusions touching the relations between tonsillar infection and goiter were that "inability to demonstrate endamebe in the thyroid gland renders improbable any direct causal relation of the amebic infestation of the tonsils per se upon the development of thyroid disturbances. However, the improvement, morphologically and symptomatically, in the treated cases leaves little doubt as to an indirect relationship. A symbiosis of endamebe with appropriate bacteria, leading to the elaboration and absorption into the thyroid of selective thyrotoxic poisons, is at least conceivable in explanation of such relation."

One of the strongest supporters of the theory of infective interrelation between the tonsils and thyroid is S. P. Beebe⁹ of New York, who has from time to time put himself on record concerning it. He calls attention to numerous observations on the relation of thyroid disease to previous infections. In this connection it is well to remember that thyroid disturbances occur most frequently in persons of a thymolymphatic constitution, and it is these individuals who are most susceptible to infections. The terminal event in hyperthyroid patients is not infrequently an infection which has begun in the tonsil. A large percentage of patients with exophthalmic goiter have enlarged tonsils and adenoids. It is not uncommon to date the beginning of a thyroid enlargement from a particularly severe attack of tonsillar infection.

Infections in the nose and throat are undoubtedly the most common to which the human family is subject, and the tonsil is one of the most important points of entry we have for infections, but in goiter the resultant condition is a hyperactivity of a gland of internal secretion and not a continued infection. It is obviously more difficult to explain such a result than to trace the connection between an acute tonsillitis and a septicemia or an infected joint.

Infection does not in a large percentage of cases produce such an enlargement of the thyroid gland that it would be

recognized as a goiter, and it may be that the thyroid does not react in this manner except in those who are not quite normal in respect to the balance of their glands of normal secretion. If the thyroid secretion is an important element in the defense against infections, it is not impossible that it is stimulated to overactivity when occasion demands, and if the stimulus be often repeated it may lead to changes which we recognize as pathologic. Through the repeated stimulus to overactivity, the gland has become hypertrophied, and its heightened function continues long beyond the stimulus which originally called it forth.

Clinically there is an important relation between the infections in the nose and throat and hyperthyroidism. In patients between the ages of sixteen and twenty-four, from 35 to 40 per cent give a history of repeated attacks of acute tonsillitis and many have enlarged tonsils and adenoids. Rapid enlargement of the thyroid, with characteristic symptoms of overactivity, has often followed immediately after a particularly severe tonsillar infection. Such patients bear these infections badly. Their convalescence is slow, and each attack is accompanied by severe prostrations quite out of proportion to the apparent severity of the infection. Dr. Beebe has observed that the leukocytosis in these cases is lower than that of non-goiterous patients, and that hypertrophied patients often show a marked leukopenia with a relative lymphocytosis indicating some influence on the blood picture operative when the organism is subjected to infection.

The tonsil infections to which exophthalmic patients are so often subject constitute most dangerous and distressing complications and the alert surgeon should always be on his guard against them. If there is an active thyroid intoxication it is seldom wise to enucleate tonsils and adenoids, because such patients react badly to operations of any sort. The anoci-association methods so successfully employed by Crile in thyroidectomy, which Beebe described as "stealing the thyroid," ought always to be employed in all operative measures on cases of this type.

The writer has felt justified in quoting thus at length from Dr. Beebe's excellent paper, as the position he occupies is in

most respects exactly analogous to the writer's own, and the opinions brought out in the discussion which followed the presentation of the paper before the Laryngeal Section of the American Medical Association so closely resemble those expressed by the recipients of the present writer's questionnaire. John F. Barnhill was emphatically of the opinion that the removal of diseased tonsils had no effect upon the progress of the goiter or exerted any beneficial influence upon thyrotoxic symptoms. This was in 1914. In 1920, Dr. Barnhill made an address to this same section on "Surgery of the Thyroid,"¹⁰ in the course of which he said: "In the last six years I have made accurate notes as to the presence of diseased tonsils in all goiter cases. More than 90 per cent of all cases I have examined have had clearly evident disease of the tonsils, and judging from the most modern point of view as to what constitutes a diseased tonsil I think all may rightly have been classed as having foci of infection in the tonsil. In more than 50 per cent of my cases of goiter in which operation was performed during this period, the tonsils were removed before the thyroidectomy, sometimes as long as a year previously, in the hope that the goiter operation might thus be avoided. It seems certainly true that after the thyroid is once diseased the removal of the tonsils has little appreciable benefit on the thyroid disease. Indeed I have seen the thyroid rapidly enlarge and the thyrotoxic symptoms increase after the performance of a most complete tonsillectomy. These observations do not, however, form a good argument against the possibility that the diseased tonsil may have been the original focus from which the thyroid received its infection. Indeed, the frequent presence of infected tonsils in thyroid cases points almost certainly to a connection between the two diseases."

Approaching the question from the thyroid side, we have the assurance of Joseph C. Beck, of Chicago,¹¹ that he has frequently found the removal of one or both tonsils to be far more efficacious in preparing a patient for a thyroidectomy than ligation of the superior thyroid arteries, which is "considered plausible procedure to cure a thyrotoxic disease or to arrest it so as to enable the surgeon to perform a more radical procedure, namely, thyroidectomy." He also found "a fairly good number of thyroidectomized patients in whom the toxic con-

dition recurred, to be much improved or completely cured by tonsillectomy." He believes that in all thyrotoxic cases it is better to proceed with a preliminary tonsillectomy, followed by the proper thyroidectomy than to reverse procedures.

Another point of interest in connection with the thyroid and the laryngologist is the early diagnosis of a thyrotoxic condition. The laryngologist is frequently the first to be consulted in reference to the headache and nervous phenomena, to differentiate between sinus disease, ocular conditions and chronic focal infection, particularly from tonsils.

Dr. Beck supported his contention by reporting the following case:

Mrs. W., age 32 years, has had a somewhat small goiter for several years. As a child had many sore throats, then none for several years. Last winter had two severe attacks of tonsillitis, following which the thyroid gland appeared to get somewhat larger. There appeared also all the classic symptoms of a thyrotoxic state without much exophthalmos. A competent internist counseled very strongly against a major operation at this time. Under local anesthesia he removed her tonsils without any difficulty, either local or general. The thyroid gland receded in two weeks, and her general condition improved very rapidly after that. It is now three years and she has not had any recurrence of her thyrotoxic symptoms. Dr. Beck has had "a fair number of such cases with similar results."

Somewhat similar is a case recently reported by Greenberg,¹² where a small goiter had been present for many years without other symptoms of hyperthyroidism. Following several attacks of "quinsy," typical thyrotoxic symptoms appeared, but were relieved by operation.

The purpose of this article, and of the investigation upon which it is based, is not so much to demonstrate a theorem, of the truth of which the writer is absolutely convinced, as it is to bring together the varying opinions and clinical observations of practitioners who have had occasion to deal with the subject from different angles, and in this way to

stimulate further study, research and discussion of what appears to him to be a highly interesting and significant situation. Beebe stated that his deductions were drawn from the history of approximately 3,500 patients who had thyrotoxicosis, and while it is quite possible for a practitioner to have a number of patients with thyroid disease who do not present infected tonsils or other apparent focal infection, he, nevertheless, felt that the fact that such infections are such a very frequent accompaniment to thyroid disease "constitutes an important factor in maintaining a condition which favors overactivity of the thyroid gland. One cannot see the effect of repeated infections in these patients without being impressed with their importance."

The writer would urge upon all nose and throat men the wisdom of making every routine examination include a careful scrutiny of the thyroid gland. While the consensus of opinion already cited seems to be that once thyroid disease is well established no amount of attention to tonsil conditions can bring about any improvement, we certainly have abundant evidence to show that a thyrotoxicosis in its initial stages may be retarded or even completely aborted by the extirpation of infected tonsils.

The suggestion contained in Dr. Poynter's reply that he believed if a relation between the tonsils and thyroid is ever demonstrated, it will be through internal secretion, opens up a wide and fascinating field of investigation. The laborers in this field are more likely to be those who are approaching the question from the thyroid side, and upon them the writer would also like to urge the necessity of minutely considering the state of the tonsils of every goiter patient presented to them for the first time. Especially in those cases where a tonsillectomy has left a certain amount of tonsillar tissue in the throat and the healed surface may still be masking infective pockets it will be well to seek the cause of the thyroid disturbance in the tonsillar region.

It is in the hope of thus stimulating interest and, if need be, arousing criticism and opposition which will result in a more widespread consideration of the entire subject, that the present effort to call attention to it has been made.

CONCLUSIONS.

The conclusions drawn by the author from the result of a canvass of practitioners whom he believed to be in a position to give information regarding the possibility of a relation between goiter and tonsil infection were:

1. That comparatively little attention had been given to a consideration of this possibility.

2. That the majority believe goiter to be largely of toxic origin.

3. The tonsil is no more likely to be the focus of infection than any other location—e. g., sinuses, teeth or gall bladder.

A survey of the scant literature relating to this subject seems to indicate that those who have investigated the coincidence of goiter and infected tonsils, and have exhaustively considered their possible interrelation, incline to the belief that diseased tonsils may in many cases be directly responsible for goiter, both simple and exophthalmic.

It is urged upon the throat specialist that he give particular attention to the state of the thyroid gland in all cases of infected tonsils, and also upon those who are called upon to treat disordered thyroids, that they bear in mind the possibility of an exciting factor in the presence of diseased tonsils.

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XXVI.

SUBMUCOUS RESECTION—COMPLICATIONS AND
AFTER-RESULTS.

BY N. S. WEINBERGER, M. D.,

ROBERT PACKER HOSPITAL,

SAYRE, PA.

Submucous resection of the nasal septum, so frequently indicated in otorhinology, cannot be studied and developed too carefully. Although the essential features of the technic have become practically standardized, this paper is written with the idea of reviewing the possibly too frequent complications and discouraging after-results, and with the view of determining in what ways their occurrence can be minimized. Submucous resection is an operation that is at times unnecessarily performed, and this is to be deprecated, but it has not yet reached the point when it sufficiently and universally displaces the mutilating operations and makeshifts of former years. The fewer the complications and the better the after-results, the sooner will this end be accomplished.

The technic will not be discussed excepting in so far as it affects the considerations of the title of this paper. Speaking in general, from what one learns from the literature and from personal experience, it would seem better if submucous resection were regarded from the standpoint of surgical risk. All patients should have a routine general physical examination, including the blood and urine, as well as a very careful local examination of the throat, teeth, ears and accessory sinuses. The operation should always be done in a hospital and the patient put to bed in the upright or semireclining position until all packing has been removed. In this way hemorrhage will be very much less frequent and the postoperative congestion much lessened, thus adding a factor of comfort to that of safety.

It might be well to consider the much discussed question of packing. As far as hemorrhage is concerned, a properly

packed nose will very rarely bleed excessively. It is generally accepted that packing increases the possibility of other complications, notably the infections of the operative field, the sinuses, the ears, the meninges or the throat. The question, therefore, resolves itself into one of relative importance and expediency in which the factor of safety must be included. Granted then that it is better to pack the nose from the standpoint of hemorrhage, we are justified in packing with the increased danger of these infections, realizing that the local result will be better and the purpose of the operation more fully served, or should we take the chance of the occasional unsatisfactory result? The infection of the operative field when properly cared for does not in itself mitigate the benefits of the operation, but rather enhances them, and infection can and does at times occur when no pack is used.

We should always obtain the best results possible and should do all in our power to minimize the occurrence of infections with the pack and thereby decrease the danger to the patient. It appears that with due precaution the evidence favors the pack in spite of the temporarily added discomfort of the patient and the possibility of infection, especially so since absence of the pack is only one of the factors of non-infection.

These precautions are as follows: General physical and laboratory examination before operation; local examination of the sinuses, ears and throat, and wherever feasible the preparatory care of any infection that may be present, either by treatment or operation, with the idea of producing as clean an operative field as possible under the conditions.

Strict aseptic technic is essential. Submucous resection should not be done in the presence of an acute infection or immediately following some other local operation, however slight. If, in case of unilateral acute sinus infection, it is imperative to do a submucous resection, the operation should be done from the other side.

Patients should be put to bed in the upright position on a backrest for twenty-four hours. They should be cautioned against attempting to blow or force air through the nose and to open the mouth and cough when there is a desire to sneeze, thus avoiding great and sudden changes in postnasal and mid-

dle ear air pressure. The diet should be liquid until the pack is removed, so as to minimize the negative postnasal and middle ear pressure occasioned by swallowing. The pack should be removed in twenty-four hours, unless for some reason it is feared that repacking may be necessary. Repacking should never be done if it can be possibly avoided. Postoperative irrigation is dangerous, especially in the hands of the patient. If irrigation is employed it should be practiced with great caution, advising the patient of the importance of avoiding forcible blowing of the nose and sneezing. When the nose is packed forty-eight hours, the second twenty-four hours favors infection proportionately greater than the first twenty-four. The postoperative reaction and congestion have abated, and the active resistance of the first day has given place to the passive receptivity of more or less traumatized tissues in addition to the prolonged interference with the drainage and ventilation of the sinuses.

Then again, the improper use of the pack unfortunately adds to its disfavor. Splints and prepared tampons are not so good as gauze wicks in that they cannot be applied so as to give uniform and even pressure over the entire septum. They are more apt to slip out of place, thus allowing serum and blood to separate the flaps in circumscribed areas. This usually occurs high up, anterior to and below the middle turbinate, where infection is most liable to occur because of less vascularity in that region.

The gauze wick pack properly applied will with more regularity leave a straight thin septum, and, all other things being equal, assists in producing the utmost benefit. The flaps are held in apposition, hematoma is rare, and subsequent ballooning of the flaps from air currents and from blowing the nose is avoided. The slightly longer convalescence is nonessential. In a series of cases the disadvantages of packing seem to be outweighed by the uniformly better after-results.

Hemorrhage of any consequence usually occurs from the bony ridge below and well forward, or from the edge of the vomer well back, and has in some reported cases been alarming, notably in a case reported by Montgomery, which came on six days after operation. It is most likely to occur in the first twelve hours after operation and less likely in the second

twelve hours. If the nose is properly packed, especially in the region of the hard parts, it seldom occurs. It is well to attack the ridge below and in front last.

The infections are usually the result of faulty asepsis, infected membranes, sinuses or tonsils. They consist of abscess and perichondritis of the septum, meningitis (nine cases collected and reported by Dabney), and acute sinusitis, especially when chronic disease is present and the nose is packed too long or is repacked, acute otitis media and mastoiditis, tonsillitis, peri- and endocarditis, septicemia and cavernous sinus thrombosis (case reported by Hays).

The middle ear and mastoid infections are usually streptococci and virulent, and often originate in the throat. Perforation should be rare and is usually due to too much haste. It results from poor elevation (not getting beneath the perichondrium), from spicules of bone and from rapid and careless operating. Perforation is unavoidable in a small percentage of cases with bad deflections, those with very sharp angles, where there is overriding and dipping in of the mucous membrane. It does no harm if the edges are free from cartilage and bone so as to allow apposition of the free edges of the mucous membrane, but its prevention should never be sacrificed for rapid work nor for cosmetic reasons alone. The removal of all deflections should not be compromised for an unavoidable perforation.

Sinking in of the nose is due to removal of too much of the cartilage of the bridge anteriorly, to improper care of post-operative infection, perichondritis and abscess and to syphilitic and diabetic necrosis.

There is a wide divergence of opinion as to the limitations of age at which submucous resection should be performed. Some operators have practically none except the very young and report a fair percentage of sunken noses in children; others do not operate after middle age nor before the facial bones have fully grown. There should be no upper age limit when ventilation and drainage of the sinuses are required. The attitude toward a lower age limit should be that of conservatism as far as possible until facial development is about complete. It is not possible to specify the lower age limit in years, because of early or late development, but, generally speaking,

the operation is contraindicated in children under fourteen who develop early. Other contraindications are untreated syphilis, diabetes, advanced tuberculosis, acute sinus disease, acute middle ear disease, atrophic rhinitis and marked hypertrophic rhinitis.

Unless all deviated portions are removed, especially those high up between the middle turbinates, those close to the floor of the nose, the ridges and spurs of the vomer well back and split cartilage or vomer, apposition of the flaps will not be good, healing not so prompt and the result is apt to be discouraging.

It is well to make drainage incisions well back to allow escape of serum and blood rather than have a collection between the flaps, which would interfere with good apposition, form a culture field for infection or leave a thickened septum or ballooning flaps. Permanent adhesions between the septum and turbinates or outer wall should not occur, as they show undue traumatism from careless use of instruments. They usually occur where, in attempting to remove a sharp angle or deviation, considerable traumatism and tearing is done to the mucous membrane of the septum and the outer wall or turbinate directly opposite, and the attempt at removing the deviation is abandoned and two abraded areas are allowed to come into apposition. Permanent adhesions should not occur in the hands of careful and thorough operators. They usually interfere with good results, or because of remaining deviation require reoperation.

The question of the anesthetic is important. Cocain and adrenalin in varying proportions and strength is the anesthetic of choice by most operators. General anesthesia is very little used in this country, and not only seems unnecessary but impractical. Subperichondrial injection of Schleich's solution has its advocates, but offers difficulties that prevent its universal adoption. The untoward effects of cocain can be minimized by preoperative general examination, operating in a semi-reclining position and avoiding excessive use of anesthetic. In this way fainting and syncope, which sometimes interfere with the progress of the operation, are practically avoided.

Cocain poisoning in susceptible patients occurs rarely and needs separate attention. Hysteria, transient hysterical paralysis, erysipelas and fracture of the cribriform plate have been

reported. MacKenzie reports a case of air embolism. An anatomically normal nondeflected septum is rare. Submucous resection should not be done because of deflection alone. We should be guided by indications and have a reasonable assurance that the patient will receive real benefit or that probable future trouble is prevented.

The operation is not entirely successful unless its interference with drainage and ventilation of the sinuses has been remedied, but when indicated and well performed often yields brilliant results.

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XXVII.

TREATMENT OF ACUTE SINUS INFECTIONS.*

BY LEE M. HURD, M. D.,

NEW YORK.

There are some cases, a fraction of 1 per cent, that require prompt and fearless surgical intervention because of the severity of the infection which has or will extend beyond the sinus limits, thereby producing grave complications.

There is a fair sized group which becomes chronic unless properly treated, but the great majority recover without attention or they undergo medical treatment or minor surgical measures.

The cardinal symptoms for which the patient seeks relief are pain, pus, pyrexia and swelling, in the order named. Many times they are treated by home remedies or by general physicians for neuralgia, or, if influenza is epidemic, the case with headache and fever is treated for influenza, even if the nose is occluded and discharging pus.

GENERAL CONSIDERATIONS.

For Pain.—Heat, electric light, diathermy or hot applications, such as poultices, are used. The electric light can be applied in the form of the Killian box, the therapeutic light or what is quite as efficient and much more simple, the ordinary droplight hung over the patient's head, so that they may get heat and light at will. Drugs—Aspirin, the coal tar derivatives and opium derivatives are prescribed.

For Congestion.—Cocain is highly recommended, but it really is irritating and extremely dangerous to give the patient as a spray; adrenalin, also is highly recommended, but its benefits are counteracted by its reaction; nitrate of silver in small doses of $\frac{1}{2}$ to 1 per cent as a local application, after the first slight irritation, gives more lasting contraction than either

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cocain or adrenalin; argyrol of doubtful service, and hot saline douches. Of the four agents I depend mainly on the saline douche and nitrate of silver.

For Pyrexia and External Swelling.—Surgical relief by drainage.

A rough working rule is that if the three symptoms—pain, fever and external swelling—are present, the case is beyond medical measures and requires prompt surgical intervention. This, like all working rules, has its exceptions. But if the infected process has extended beyond the sinus limits, usually into or about the orbit, producing cellulitis, abscess, caries, osteomyelitis, ocular symptoms or cavernous sinus symptoms, though these conditions are very rare, they require prompt external operations for the relief of pressure and drainage of the sinus and the infected area.

TREATMENT DIRECTED TO PARTICULAR SINUSES.

Acute Ethmoiditis.—The medical treatment outlined above under general considerations meets the requirements of acute ethmoiditis and very rarely indeed is surgery indicated. This may be required by an extension of the infection through the sinus walls into the orbit or threatening the anterior cranial fossa, which may call for an external operation by the orbital route.

ACUTE FRONTAL SINUS INFECTION.

The usual medical measures to reduce the congestion within the nose, with suction to reduce the amount of pressure within the sinus, will usually suffice. If there is the slightest evidence of swelling of the lids or an elevation of temperature it becomes necessary to remove the anterior portion of the middle turbinate and break down the anterior ethmoid cells which form part of the floor of the frontal, to establish drainage. It is possible only in a few cases to catheterize the frontal sinus without this surgical measure. If it does not promptly relieve the temperature and swelling, it becomes necessary to invade the sinus through the eyebrow, but this is extremely infrequent and it is done to relieve such conditions as orbital cellulitis, osteomyelitis and caries.

There is one type of acute frontal sinus which is characterized by a periodic neuralgic pain which comes on at nearly the

same time in the morning and as suddenly ceases about the same time in the afternoon, and the patient feels quite well from that time until the next morning. I have no satisfactory explanation for this type; though they suffer the most pain, they are not inclined to be as serious as the more common type.

If the pain is not too severe and does not extend over too many days, I try, by the aid of local depletion, suction and diathermic heat externally, to evacuate the secretion, which is of a thick mucoid character, rather than purulent, because as soon as this thick collection is removed from the sinus the pain disappears. I have demonstrated that in several severe cases, by enlargement of the frontal orifice and douching out this mucoid plug, the pain promptly disappears.

The sphenoid sinus, besides the general measures, can usually be catheterized and the contents douched out. If it is impossible to catheterize, I depend upon suction. If suction fails to give relief, the severe pain indicating much pressure, I take down the anterior sphenoid wall.

ACUTE ANTRAL DISEASE.

A very few are of dental origin. This can be relieved only by the removal of the offending tooth. The antrum should be douched and if possible the antral cavity should not be connected with the mouth. If it does, the tooth socket should be packed with iodoform gauze.

The vast majority of cases are due to extension of the infection from the nasal cavity. For the pain, electric light or diathermic heat should be applied, local depletion and suction, with the head on a horizontal plane and the affected antrum uppermost. But the best method is to douche the sinus with saline through the normal orifice if possible, otherwise by needle puncture through the inferior meatus.

The washings from an extremely acute sinus in the very early stages will be clear to cloudy or bloody serum. This may abort the infection from going on to a frank pus, but usually by the time the patient consults the physician the antrum contains pure pus or mucopus. The antrum should be douched according to the severity of the infection, every day or every other day.

Diathermic heat should be applied over the frontal or antrum, as the case may be, in the form of a small metal plate about the size of the sinus, and another larger plate on the back of the neck, and the current should be used up to the tolerance of the individual with the heat created, without burning the skin. This will actually raise the temperature within the sinus and, if used from five to ten minutes, will relieve the pain.

Suction is much under controversy as to its value. There should be no discussion as to its merits for diagnosis, and it is often a valuable adjunct to treatment. In fact, it should be routinely used in acute infections of the sinuses where it is impossible to catheterize and douche them out. It is necessary to control the amount of vacuum used by a reliable gauge, usually between 10 and 15 inches being employed, or less if the patient cannot tolerate it. This should be reduced by a proper tip in one nostril, the other nostril closed and the nasopharynx shut off, having the patient say k, k, k. The vacuum should not be continuous, but should be on for a second or two and then broken, and rapidly repeating this procedure a number of times or, in fact, as long as the suction produces pus. It is well to keep the suction down to a point below which it extravasates blood.

XXVIII.

SOME FURTHER OBSERVATIONS ON THE ETIOLOGY AND TREATMENT OF MAXILLARY SINUSITIS.*

BY HOWARD V. DUTROW, M. D.,

DAYTON, OHIO.

It is interesting to note, in reviewing the literature, the great diversity of opinion as to the etiology and treatment of maxillary sinusitis, but upon close analysis it is evident that steady progress is being made and something approximating standardization achieved. No doubt, the demand for more knowledge regarding the diagnosis and treatment of infections of the nasal accessory sinuses in general has been actuated by the indifferent end results obtained by many good workers in this field. Hence the voluminous amount of literature and the many conservative and radical surgical procedures elaborated to meet all classes of cases.

It has been our too frequent experience in years gone by to operate two or three times upon a case of chronic maxillary sinusitis, and even then to find results disappointing. This condition has improved in that most of us are now giving much more study and attention to diagnostic and operative refinements and are consequently getting better results.

Heretofore most of us were inclined to regard the antrum as a reservoir into which pus drained from infected frontal and sphenoid sinuses and from the ethmoid cells. I am confident that the ratio of the source of infection has to be reversed. Surely more infections are now known to be due to infected teeth and are commonly termed ascending infections, as compared to those coming from above, or descending infections. The percentage due to the teeth has been variously estimated from as low as 8 per cent to as high as 100 per cent. Two years ago I stated in a paper read at Kansas City, that from

*Read before the Ear, Nose and Throat Section of the Ohio State Medical Association at Cincinnati, May 4, 1922.

65 to 70 per cent were of the ascending type. Some have felt that the percentages quoted were entirely too high, but I am confident that these same men now would consider them more nearly correct. It is very seldom that we find a chronic maxillary sinusitis in a case where the dental line is unbroken. If the teeth are examined and a careful history regarding them obtained it will be found, in a great majority of cases, that a first molar tooth, more frequently, and very often the second molar tooth, or both, have been extracted. Many crowned or filled molar teeth whose pulp and nerve supply has been killed will also be noted.

Freer, of Chicago, has recently stated that it is his belief that practically all sinus infections were of the ascending type. While his estimate may be too high, I believe it more nearly correct than the estimate of those who claim a maximum of only 8 per cent ascending infections.

To prove further my conclusions as to the preponderance of the ascending over the descending infections, I recently had a case of chronic empyema of the left sphenoid sinus, which was of fifteen years' duration. In making a diagnosis of this case by process of elimination, transillumination and X-ray findings, the antra were negative, but the sphenoid sinus showed a definite empyema; the antrum was irrigated through the ostium and the fluid was returned perfectly clear. The ethmoid labyrinth had been partially exenterated fifteen years previously, but the sphenoid sinus was not suspected at that time. Here was a case of pus pouring out of the ostium of the sphenoid for fifteen years, yet there was no infection of the maxillary sinus.

Another case to support my belief as to the source of infection was one of chronic maxillary empyema, in which the first and the second upper molar teeth on the same side had been extracted some twelve or fifteen years previously, and for which a rhinologist some eight or ten years ago removed some nasal polypi, but did not do a middle turbinectomy. A Caldwell-Luc operation was done and the sinus found to be filled with granulations, some of which were protruding through the ostium into the middle meatus. There was some fetid discharge from the sinus for about a week or ten days following the operation, which had to be washed out. Improvement was noticeable

after each succeeding irrigation. The discharge was rather slow in disappearing, and it was felt that, according to the generally accepted belief, there might be some drainage from above into the antrum. An ethmoid exenteration was done, for which I have my own personal regrets, because there was absolutely no pathologic condition within the ethmoid labyrinth. In fact, the morning I had selected for the ethmoid operation I debated as to whether or not it should be done, because the discharge from the sinus was practically absent. I here wish to caution against too much haste in destroying the middle turbinate and ethmoid cells, if there is still some discharge following a Caldwell-Luc operation. A reasonable length of time should elapse in the hope of saving the intranasal structures.

During the past several years I have had many cases in which, upon examination of the nose, I found the middle turbinate and ethmoid region bathed in pus, with some polypoid degeneration of the mucous membrane, which was in constant contact with this secretion, to clear up entirely and remain normal after a Caldwell-Luc operation.

I believe that an infected maxillary sinus is far more likely to infect secondarily the ethmoid labyrinth and even the frontal and sphenoid sinuses, rather than the reverse.

Most of us forget the fact that we occupy the horizontal position eight to twelve hours out of every twenty-four, and it is at this time that the head is very often somewhat lower than the plane of the body, and infectious material can easily find its way into contiguous sinuses and cells, thus producing a secondary infection. The middle turbinate normally forms a complete cap over the ostium, and anatomically it is difficult for secretions to enter the sinus through the rather slitlike or oblong ostium.

I have not had a case of reinfection of the maxillary sinus to occur following a Caldwell-Luc operation. In more than 90 per cent of these cases no intranasal structures received any surgical interference at my hands whatsoever. Some had had some intranasal work done previously by other men.

This is a point, I believe, worthy of serious consideration, because, if the principal source of infection is from above, nothing has been done to prevent a subsequent infection. My

remarks are not to be construed as indicating that infection from above is not possible, but it is very rare, and therefore the structures of the upper part of the nose should be saved in every way possible. The permanent anatomic and physiologic damage done by a well performed Caldwell-Luc operation is negligible as compared to that of a destructive intranasal operation.

The old theory of Jansen that if one sinus is infected, all of the same side would be infected, is obsolete and, I believe, thoroughly disproved. To open all of the sinuses on one side because one happened to be infected is meddlesome surgery. Much time and care should be given the question of diagnosis to determine as accurately as possible which sinus or sinuses are involved. The old shotgun diagnosis is a thing of the past, because we now know that the infection may be limited not only to one sinus but even to a compartment or one-half of a sinus.

My end-results in some forty-odd Caldwell-Luc operations performed during the past three or four years have been eminently satisfactory from every standpoint. Prior to that time I was rather discouraged with my treatment of chronic antrum infections, but after careful study and strict attention to operative detail better results were obtained.

Much has been said regarding the loss of nerve supply to the incisor and canine teeth of the operated side. I have had only one case in which this sensibility was permanently lost, and I am quite sure that in this case I made my opening too low and severed the nerve supply. Some men have taken the graphic nerve distribution to these teeth, as shown in Gray's Anatomy, as correct. I believe this graph was made for purposes of illustration only. The nerves are shown as coming off in a fan shaped distribution from above downward, from the infraorbital foramen, and if this is true we would have loss of sensibility in the teeth so supplied in every case operated upon. As a matter of fact, the nerve supply goes almost vertically downward, just posterior to the canine fossa, and comes forward in the dental foramen. If the opening is properly placed as near the center of the canine fossa as possible and enlarged peripherally, care being taken not to carry the re-

moval of bone too far downward, this complication need not arise.

I am sure that if most of us will compare our technic of operation of today with that of three or four years ago, we will not be at a loss to account for our more successful treatment at the present time. Now we make an effort to see clearly all of the ramifications of the sinus and curette firmly but gently all visible pathology. In this curettement I am not sure that all of the mucous membrane is removed, certainly none of the periosteum if healthy should be removed. But it is absolutely necessary to get out all granulating tissue, no matter where it may be found. The ostium should be carefully inspected and all granulations removed. The concavity which extends into the malar bone is a very frequent hiding place for a large granuloma, as well as above and posteriorly, just beneath the orbit and in front in the angle above the incisor teeth. The slogan of all radical surgical procedures in sinus work should be absolute thoroughness in removing diseased tissue. The nasal opening should be carefully and skillfully made and a flap preserved and made to lie upon the floor of the sinus, thus covering the angle of bone which formed the nasoastral wall of the inferior meatus. It is an anatomic impossibility to have the floor of the nasal fossa on a level with the floor of the antrum, as in practically all cases the floor of the antrum is from one to three or four millimeters below the floor of the nose. This, however, is immaterial for ample drainage, because of the many changes in the posture of the body.

Another great permanent advantage of a good sized nasal opening is the constant aeration of the sinus. It is known that for granuloma to grow or thrive, they must be protected from the air. This, I think, explains why, if a large enough opening is made in the inferior meatus, one that cannot grow shut, these cases remain well. It may be argued that the sinus under normal conditions is filled with air. This may be true, but the ingress and egress must be through the ostium, which may be closed for long intervals, depending upon the congestion of the nasal mucosa, whereas, if the opening in the inferior meatus is large enough, the air is constantly changing.

Irrigations should be used with great discrimination. There are cases where they are positively beneficial for a short time or for as long as they may seem to be needed, but they should be discontinued as soon as the sinus approximates normal.

There need be no argument that the radical surgical treatment is best adapted to the chronic infections. There are undoubtedly cases of acute antrum infection, the source of which may be through the blood stream or by continuity from the nasal mucosa, or through the lymphatics, and it is in these cases, if seen early, that puncture and irrigation will cure. But if the case is of long standing, it is like dealing with an unknown quantity to rely upon puncture and irrigation. You are groping in the dark.

To illustrate, I will cite briefly an observation. A child ten years old, with a chronic right maxillary sinusitis. The skiagraph showed unerupted teeth well up in the canine fossa, and it was considered inadvisable to do a Caldwell-Luc operation. This little patient was operated upon through the inferior meatus. A large opening was made and as much of the polypoid contents of the antrum removed as possible. The operation was done some six or seven months ago, and the child has had to be irrigated at least once a week ever since. She has made slow but steady progress, and the discharge now is very little. She has gained considerable in general health, but I am not satisfied with the interior of the sinus, because I am confident that it is at least partially filled, and will remain so, with granuloma. The ciliated epithelium, which some authors claim to do a great deal in wafting secretions toward the ostium, do not seem to have accomplished very much in this case.

The improvement in general health of the cases operated upon for antrum infection of long standing is most remarkable. These patients gain in weight, sleep well and the vague neuritic and myalgic pains disappear and they are very much benefited in every way.

CONCLUSIONS.

We should not be carried away by any one method of treatment to the exclusion of all others, but cases should be thoroughly studied and the procedure adopted that is going to give

the best complete and permanent results.

1. Definite progress is being made in the diagnosis and treatment of maxillary sinusitis.

2. Observations indicate that our earlier ideas as to the etiology and sources of infection have to be revised.

3. Destructive intranasal surgery should never be resorted to until after the diseased antrum has been treated and sufficient time has elapsed for the structures within the nose to return to normal.

4. No reinfections have occurred following a Caldwell-Luc operation, in which the middle turbinate and ethmoid labyrinth remained intact, thus disproving to a great degree the theory of descending infections.

5. In chronic empyemas with granuloma, absolute thoroughness in removing all pathologic conditions within the sinus, together with adequate drainage and constant ventilation, are three cardinal points necessary in the satisfactory treatment of these cases.

6. End-results as to absence of deformity or destruction of physiologic structures and the greatly improved condition of the patient fully justify proper radical surgical intervention in this class of sinus infection.

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XXIX.

THE UPPER RESPIRATORY TRACT IN GRANITE
DUST INHALATION.*

By D. C. JARVIS, M. D.,

BARRE, VT.

Vermont having the largest granite center in the world, the opportunity to study the effects of granite dust inhalation upon the respiratory tract is exceptional. A permanent residence rules out the time factor and makes it possible to carry the work to any conclusion thought advisable. Observing the upper respiratory tract of granite cutters for the past twelve years, one's attention could not fail to be focused sooner or later upon their difficulties, and in 1917 a definite effort was made to observe in detail the condition these men manifested.

Introduction.—The accumulation of cases was slow, and the advent of the National Tuberculosis Association in the field during 1919 was welcomed. Through its Committee on Mortality from Tuberculosis in the Dusty Trades, an investigation of the granite industry was started because it was thought that the granite industry, of all the dusty trades, would show the highest mortality from tuberculosis. The investigation was divided into three phases: A statistical inquiry, a mechanical process inquiry and the medical examinations. The granite cutters have shown a remarkable spirit of cooperation. They did not appear because of any illness but came up for examination in routine order by previous arrangement. This previous arrangement consisted in taking the subject up with the Executive Committee of the local union, which in turn called a meeting of the men for a consideration of the subject and action. Many of them had never had occasion to consult a physician before. They were all able to work and considered themselves in good health. At this time it is possible to report on the examination of 500 granite cutters.

Review of the Literature.—While numerous references are

*Candidate's thesis. American Laryngological, Rhinological and Otological Society.

found in the literature to dust inhalation in general and some forms in particular, from Ramazzini's article in 1700 down to the present time, one fails to find a record of a definite study of the effects upon the upper respiratory tract of granite dust inhalation. The term "stone cutters" is found, but with no particular effort to separate granite cutters from marble workers and stone masons. The general report of the Miners' Phthisis Prevention Committee of South Africa, published under date of March 15, 1916, comes the nearest to the present work, but their similarity lies in the composition of the stone and not in the manner of handling. The South African process I understand to be a blasting one, while the Vermont process is in finishing the stone for monumental purposes, the stone being worn down by means of a pneumatic tool. The work in Vermont represents the first work of the Committee on Mortality from Tuberculosis in the Dusty Trades. The only other investigation of a dusty trade in this country is represented by the valuable contribution to be found in United States Bulletin No. 85, issued January, 1917, comprising a clinical study of 433 cases of miners' consumption among zinc miners in Southwestern Missouri, by A. J. Lanza.

Experimental Pathology.—Dr. L. U. Gardner of the Saranac Laboratory is in charge of the experimental pathology connected with the investigation, and the reader is referred to his article in the December, 1920, number of the American Review of Tuberculosis for the preliminary details of this phase of the work. One specimen from the upper respiratory tract examined by Dr. Gardner was reported as follows: "Examination of tissue from granite cutter's nose of September 25th shows a mucous polyp composed of a mucous connective tissue stroma covered with columnar epithelium on the surface. Mass contains frequent gland acini and in places infiltrated with plasma cells. No trace of granite dust nor any reaction suggesting this irritant."

Evidence on Which Report Is Based.—The economic phase was so important that attention was paid to small details, such as the presence of a mustache, its growth as to luxuriance, the length of time it had been worn, and the amount of hair in the nose; the condition of the septa, the turbinates; the presence of lymphoid tissue upon the posterior pharyngeal wall; the

condition of the tonsils, teeth and the larynx. From the observations necessary in accumulating this evidence the deductions and conclusions made in this thesis have been derived.

COMPOSITION OF GRANITE REPRESENTED BY THIS STUDY.

Silicon dioxid.....	69.56
Aluminum oxid	15.38
Iron oxid.....	2.65
Magnesia oxid.....	Trace
Calcium oxid.....	1.76
Sodium oxid.....	5.38
Potassium oxid.....	4.31
Manganese	Trace
Loss in ignition, CO ₂ and moisture.....	1.02
	<u>100.06</u>

According to Gardner, when examined under the microscope the unscreened dust may be roughly divided into large and small particles. The former, which could not possibly be concerned in an inhalation experiment, show an average size of 82 x 84 microns. The smaller particles average 4.3 x 6.3 microns by actual measurement. In shape the particles may vary greatly. Some are flattened polygonal masses with sharply cut edges and corners. Others are rod shaped, often slightly curved with sharply horizontal or square cut ends. Frequent vegetable cells and fibers are noted. Samples of dust resulting from the use of the pneumatic tool have been examined by means of a small giant magnet made by the Victor X-ray Corporation and considerable steel has been extracted from a given quantity by means of the magnet, 2 drams of granite dust yielding 2 grains of steel. From this experiment it will be seen that we are dealing with two kinds of dust, that from the stone being worked and that from the tool used in working it.

Present Problem.—In 1915 there were 2050 granite cutters working, while in 1919 only 1240. The question suggesting itself, whether this condition was peculiar to Vermont alone, the total number of cutters for the United States was investigated and it was found that there was a corresponding diminution in the number of cutters throughout the whole country. The statistician returned the report that an analysis of the

death certificates for the past twenty years indicated that 86 per cent of the cutters died from tuberculosis. The present study was undertaken to determine if possible the part played by the nose and throat in the developing of the clinical condition. A study of the industry reveals men who have inhaled granite dust with impunity over periods ranging from thirty to fifty-nine years, and other men who are punished severely by granite dust inhalation even when less than fifteen years represents their period of exposure. Why do some men suffer severely from the effects of dust inhalation, and why do others escape so easily?

The Occupation in Itself.—An occupation that is dusty does not justify the conclusion that affections of the respiratory tract are prevalent to a large degree. Also if an individual working in a dusty trade develops an affection of the respiratory tract, dust inhalation may not be the cause. There are other factors, such as hygienic conditions, to be considered, and while a close study of granite dust inhalation reveals the fact that a certain proportion of the men have an affection of the respiratory tract superimposed. One who works among these men daily cannot help but feel that a vicious circle is developed; that the inhalation of granite dust in itself is not a producer of a serious respiratory disease, but rather produces other conditions of the respiratory tract less serious, such as frequent colds, bronchitis and pneumonia, which in turn prepare the respiratory tract for the tuberculous process.

Suitable Soil. As one works longer among these men, there comes a feeling that certain ones represent suitable soil for the early manifestation of the injurious effects of granite dust inhalation. Knowing that all men were not safe in the industry, and that some broke down earlier than others, it became necessary from an economic standpoint to ascertain if possible the type of individual who would not last long in the industry under present working conditions, and to suggest that he take up some other trade. While the period of apprenticeship is three years, it takes between eight and nine years to bring a cutter to a final degree of excellence. Although these men have been studied during the past twelve years, it is only during the past five years that an effort has been made to discover the type of individual who might be accepted as an apprentice.

This type represents a hazard which, if accepted, would soon break down in the industry and represent an economic loss to both industry and state. It seemed advisable to first examine the survivors in the industry to ascertain if possible the individual characteristics they possessed and their mode of life. Accordingly cutters who had inhaled granite dust as long as fifty-nine years were examined and detailed data kept of their condition. As stated before, the economic phase was so important that attention was paid to small details. Cutters who had broken down were examined and also several hundred cutters who were working all the time, endeavoring to find the type of individual who would last reasonably long in the industry. As a result of all this work, we are able to tell the type of individual representing a hazard, and keep him out of the industry and select the individual who would do well. It was found that the upper respiratory tract held the key to the situation and that an individual was a good risk in proportion to the absence of lymphoid tissue in this region. An apprentice with normal turbinates, a smooth posterior pharyngeal wall, tonsils small in size, no evidence externally of enlarged lymph glands, represented a desirable type and one who under ordinary conditions would last in the industry. On the other hand, if a young man 20 years of age showed hypertrophic rhinitis, enlarged tonsils and lymphoid nodules on the posterior pharyngeal wall he should keep away from the industry, as he will break down early under present working conditions without dust removing devices. On the basis of suitable soil, it was found that the different nationalities lined up in a definite manner. In order of excellence they were found to line up somewhat as follows: Italians, Americans, English, Spaniards, Scotch, Swedes, Norwegians, Danes, French and Irish. You will notice that there is a geographic distribution of these races, many of those being least affected by the dust, such as the Italians, living in Southern Europe, and many of those along the last of the list living in Northern Europe. They may be also classified on the basis of those living in dusty countries and those living in countries not so dusty. It cannot be denied that, in the granite industry at least, the Irish are punished severely, and it is a question whether they should be in a dusty trade, certainly not in the granite industry, as they

represent a hazard, under present working conditions, and should not be accepted as apprentices.

Suitable Preparation of Soil.—As a result of granite dust inhalation there occurs an adaptation to occupation of the upper respiratory tract which may be estimated in various ways. If a pencil point is drawn across the posterior pharyngeal wall of a cutter he will not know by the feeling that anything has touched his pharyngeal wall. A laryngeal mirror may be held against the soft palate indefinitely, and the cutter states that he feels nothing in his throat. The ordinary gargles are tasteless to him and he recognizes them only when they are very hot; all throat applications must be increased in strength.

The adaptation to occupation is best studied in connection with the eye, for here one is able to remove foreign bodies from the cornea without the aid of cocaine, and these may be present without the usual accompanying signs of irritation. Small pieces of granite 2 to 3 mm. in length have been observed floating about in the conjunctival sac without the cutter knowing of the presence of a foreign body. This adaptation to occupation apparently is a defense whereby dust inhalation is tolerated. While, however, it acts as a defense during continued work it acts as a detriment when absence from work results for any great length of time, because in proportion to the length of time a cutter remains away from work does he lose his adaptation to occupation. It is a well known fact that if a cutter is absent from work one month, on his return for the first three or four days he expectorates a great deal of dust, which comes up in little round balls, moist on the outside, but when rolled between the thumb and finger the center of these little granite balls is found to be dry. With the passing of three or four days this is discontinued, as adaptation has again occurred. With longer periods of idleness this adaptation to occupation is not so easily regained. Cutters themselves have discovered that something happens as a result of these periods of idleness brought on by strikes, lockouts or poor business, because they have observed and so state that a resumption of work following one of these periods of idleness causes the breakdown of many men. Granite dust inhalation in itself is not the direct cause of tuberculosis, but it is the suitable preparation of the soil when a cutter is en-

deavoring to reacquire his adaptation to occupation that assists in spelling his downfall.

Here then we have a vicious circle, granite dust inhalation requiring adaptation to occupation of the respiratory tract, absence from occupation causing him to lose this adaptation and a reentry into the industry producing irritation of the respiratory tract while he is endeavoring to regain his lost adaptation. This last effort brings about a suitable preparation of the soil. With two hundred dusty trades listed in the United States, one wonders how much this adaptation, lost and regained many times during a worker's occupational life, is a factor in the production of disease of the respiratory tract. Certain it is that if a cutter absents himself five years he may return if his initial exposure has been less than ten years, but any cutter who has been absent from the industry two years should think twice before reentering, because the difficulty in regaining adaptation to occupation represents a handicap too great for many to overcome, and suitable preparation of the soil takes place, with the resulting development of a tuberculous process.

Mouth Breathing.—According to the experience of Watt Irving, Johnson and Stewart, in the South African investigation, the mouth breather is more apt to suffer from the effects of granite dust inhalation than one who employs nasal breathing. Particular interest has been taken in this phase of this subject, and Roentgen ray films of cutters showing mouth breathing were separated from those showing nasal breathing, and a study was made, comparing them with other films of the same exposure period. The result shows that the films belonging to those breathing through the mouth show less lung lesion than those breathing through the nose. The explanation is that the usual curve of the inspired air is broken by mouth breathing, and the dust impinging upon the posterior pharyngeal wall is expectorated as soon as the accumulation warrants or is swallowed, with the result that very little reaches the trachea, and the lungs are consequently spared.

The Nose.—While the septum showed deviation in a number of cases, the turbinates did not give evidence of hypertrophy, apparently adaptation to occupation taking place readily. It would seem from this study that inhalation of a dust as irritating as granite does not exert a marked influence upon the

size of the turbinates, the causal factors producing hypertrophic rhinitis coming from within rather than without the body. The wearing of a mustache or the amount of hair in each vestibule did not seem to exert an influence upon the appearance of the roentgen ray films.

Diet in Relation to Lymphoid Tissue.—The diet was investigated, and it was possible to study ten nationalities in this respect, with the result that the evidence showed that the more greasy the diet the less amount of lymphoid tissue there seemed to be in the upper respiratory tract.

Practical Application of the Evidence Gained From This Study.—1. In view of the fact that adaptation of the respiratory tract to occupation occurs in dusty trades, when bronchoscopy becomes necessary, the patient's occupational history should assist in deciding upon general, local or absence of anesthesia. It would seem that, in a granite cutter at least, the passage of the bronchoscope might be accomplished without the aid of an anesthetic.

2. An individual it would seem is susceptible to affections of the upper respiratory tract in proportion to the amount of lymphoid tissue present.

3. When an individual contracts tuberculosis, assistance in its prognosis may be gained by studying the lymphoid tissue of the upper respiratory tract, the prognosis being better in proportion to the absence of lymphoid activity in this region.

SUMMARY.

1. The evidence tends to show that there exists in certain individuals suitable soil for the development of respiratory diseases.

2. In the worker in a dusty trade, adaptation of the respiratory tract lost and regained many times often acts as suitable preparation for developing a serious respiratory condition.

3. Mouth breathing is not as injurious as nasal respiration in granite dust inhalation.

4. An irritant such as granite dust from without does not seem to produce an increase in size of lymphoid tissue in the upper respiratory tract.

5. An inquiry as to the occupational history may assist in deciding the method of anesthesia when contemplating work upon the respiratory tract.

XXX.

PULMONARY ABSCESS FOLLOWING NOSE AND
THROAT SURGERY.

BY JOSEPH PRENN, M. D.,

BOSTON.

In the A. M. A. Journal of August 12, 1922, Dr. Chipman and many other colleagues discuss the cause and prevention of lung abscess following nose and throat surgery.

We may state right from the outset that this complication is not a frequent one. It is rather unusual. If I remember rightly, at the A. M. A. convention held in Boston in 1921, when a similar discussion took place, one doctor cited 3,000 consecutive tonsillectomies without any such complication. Still it does happen occasionally.

The prevailing opinion is that the lung abscess is due to aspiration of infected material and that it is not likely to be of embolic origin; that when such a complication does occur it is due to some faulty technic somewhere, before, during or after operation. This faulty technic might, however, be unavoidable at the time.

If the patient has infected sinuses with an overflow of pus in the nasal chambers and nasopharynx, or if the pus appears on deep inspiration, or the patient has a bad nasopharynx, it is well to clear out the nares and nasopharynx with some medicinal application just before administering the ether.

As to the *modus operandi* during etherization and operation.

Opinions vary as to the preference of deep and light narcosis in nose and throat surgery. The advocates of one claim that the other may be responsible for lung abscess complications.

Those who are for light anesthesia reason that as long as the mucous membrane reflexes are not abolished, the patient will cough up anything aspirated, and thus prevent the infected material from lodging in the lungs.

We may call this method a second prevention. For once the patient has to cough up, then he has already aspirated, fluid has gone through his glottis and found its way in the larynx or bronchi. After coughing there is also usually a deep inspiration.

Under light anesthesia there is more bleeding, as a vasodilatation takes place.

Under deep anesthesia we simply mean to put the patient "under" so that the reflexes are abolished and the operator is not required to pause too often in his work. There is less bleeding and he can do his work more neatly and speedily. Of course, in certain selective cases the operation can be done under primary anesthesia.

The prime factor in prevention is not to allow infected material or blood to be aspirated.

When there is a great deal of bleeding, when the oropharynx is filled with blood, there is enough for the stomach and lungs. Hence, this part has to be minimized. Clamping of goodly sized cut vessels, when present, after enucleation is very important. Not alone does this afford us a clean field, but it also helps to prevent absorption from the nasopharynx through these open vessels. That is probably the reason that some patients who are operated on tonsils for rheumatism get a reaction after the operation and feel worse for a time.

The surgeon who is doing a thyroidectomy clamps the thyroid and closes all the bleeding points, not alone for the sake of leaving a clean field, but also and perhaps mainly to prevent absorption. (This procedure will serve well to obviate lung abscess of embolic origin.)

Then comes the position of the patient. Some etherize the patient in a sitting position. It is very good in many cases, when the heart is not involved. It affords good drainage, especially when there is sinus involvement.

During the operation the surgeon who sits in front of the patient can direct the etherizer when to lower the head forward to drain out secretions and, with proper amount of sponging out, can keep the throat clean so as not to be annoyed when enucleating the other tonsil.

Dr. Chipman asserts that "the right lung is involved much more frequently than the left because the right lung is larger and because the right bronchus is larger and straighter than the left, so that the entrance of infected material in the right lung is more direct and easier than in the left lung."

We must appreciate the anatomic variation of the two lungs as to their size. The right lung, though "shorter, is larger, of more capacity, and greater weight."

Infected material and blood by aspiration is therefore more apt to be drawn in by the larger lung, which is the right. Imagine two bellows of different sizes connected by one pipe having a widened out upper end, funnel like. The larger bellows is the one to draw in with greater force, hence greater velocity and solids and viscid fluid will be more apt to be sucked in by the larger one.

Added to the above we must consider the fact that it is customary for the throat surgeon to operate on the right tonsil first. Then the force from above (the source of the bleeding vessel), the gravitation and the greater suction (velocity) are all on the right side. Even though the infected material must pass through the narrow glottis, we still might consider the first two factors as adjuvants to the third one, velocity.

So when the right side has not been taken care of well, and the somewhat necessary change of position of the head more to the upright or slightly tilted backward while enucleating the left tonsil, a right lung abscess may ensue.

Then comes the postoperative stage. The position of the body and head as to drainage is essential. Otherwise the care is the same as for any patient coming out of ether.

One more point we must consider in the causation, or at least the predisposition, of this complication: The condition of the lungs of the patient at the time and also previous to the operation. When trouble is suspected we must investigate it, whether there is or recently was some existing tuberculous focus.

History, physical examination and X-ray may help.

The writer remembers a case of a young man on whom he had done a submucous resection to relieve nasal obstruction.

The patient was ambitious, but became easily tired and exhibited a lack of vitality. A negative history was given, concealing for some reason the fact (as has been revealed later) that he had hemoptysis about a year previous.

The usual physical examination before administering the ether proved to be negative.

The patient luckily made an uneventful recovery.

I heard, however, that the patient died about a year later from pneumonia, following tonsillectomy.

XXXI.

INFECTION OF THE ACCESSORY SINUSES IN
CHILDREN, WITH REPORT OF CASES.*

BY EDWARD A. LOOPER, M. D.,

BALTIMORE.

During the past few years a great deal of attention has been directed to the relationship of infected tonsils and adenoids to diseases in the upper respiratory tract. So many articles have been written on this subject and so much investigation has been concentrated on these structures as a focal point for the entrance of organisms that we at times lose sight of the fact that there are other areas in this vicinity which may be playing an important role in the etiology of the disease. This applies particularly to children who have a primary or associated involvement of the accessory sinuses.

It is a common practice to attribute all chronic colds and all cases with nasal discharge, regardless of location, character or amount of secretion, to diseases of the tonsils and adenoids. It is often taken for granted that this is the only factor to be considered, while in fact the true source of the infection may be in the paranasal sinuses.

The importance of investigating this field is impressed upon us when we frequently encounter children who have had their tonsils and adenoids removed, but who do not get the desired relief of their symptoms. They give a history of colds being as frequent and the nasal discharge as constant and as severe as before operation. The operation is frequently considered as an unjustifiable procedure, the results being unsatisfactory to the patient and embarrassing to the surgeon.

A situation of this kind can be avoided if more attention is paid to the sinuses before the tonsils and adenoids are removed. In all cases of children with inflammatory lesions around the nose and throat, where the nasal symptoms predominate, the sinuses should be examined.

*Candidate's thesis: American Laryngological, Rhinological and Otological Society.

Where there is a great deal of sneezing, congestion of the turbinates, constant colds with thick profuse nasal discharge, a careful investigation of the sinuses is called for.

If the diagnosis is correctly made, treatment can be properly instituted and the results will be satisfactory.

While children are not as susceptible to diseases of the sinuses as adults, the condition is frequent enough to require careful consideration. In fact, the subject requires more attention than is generally given to it by rhinologists.

Haike¹ made an autopsy study of 394 cases of children. He opened the sinuses of 62 cases and found 52 of this number diseased. The ages were from nine months to thirteen years. Forty-seven cases had an infection of the maxillary antrum, two of the sphenoids and three had an involvement of the ethmoid cells.

Dean and Armstrong² investigated the sinuses in a group of children presenting the common symptoms of infected tonsils and adenoids. One hundred and forty-five cases were examined, and of this number 65 showed some definite involvement of the sinuses.

In a similar group of cases White³ made X-ray studies of 50 children who had been admitted to the hospital for tonsillectomy and adenoidectomy, and out of the 50 cases 41 showed pathologic sinuses.

Apparently one reason why this condition is not suspected more frequently is because there is still a prevalent opinion that the sinuses in children are so undeveloped that they do not play an important part in the etiology of early nasal infections.

In an effort to clarify this misconception, I will briefly mention our present knowledge of the anatomic construction of the sinuses in infants and children.

Considerable work along this line has been accomplished by Onodi,⁴ who has made an extensive anatomic study of 102 skulls. The material was obtained from fetuses six and a half to eight months, from the newborn, and from children one to nineteen years of age.

Since his work our knowledge of this subject has been further supplemented by the valuable investigations of Davis,⁵ and more recently by the contributions of Schaeffer.⁶

The general opinion is that the frontal sinus makes its appearance from the end of the first year to the beginning of the third year.⁷ It develops slowly and is about the size of a pea between the sixth and seventh year. From the seventh to the ninth year it is recognized as a distinct cavity.

The maximum development is reached during the nineteenth year, when it measures from 16 to 21 mm. in height and from 21 to 24 mm. in width.⁸

The sphenoid sinus is merely a faint depression in the body of the sphenoid bone at birth. Its real development begins at the end of the fourth month and generally increases in size until the sixteenth year.

The ethmoid cells are present in the newborn, as shown by Curran,⁹ who dissected fetuses from three and one-half months to birth. They develop in size with advancing years until puberty.

The maxillary antrum is most frequently infected in the child, as it has the earliest and greatest development.

According to Gegenbaur,¹⁰ "The first rudiment of the maxillary antrum is the first to appear, being seen even before the middle of fetal life, but it does not attain its complete development until comparatively late, nor does it show any considerable growth before the second year of childhood."

At birth it occupies a small space to the inner side of the orbit.¹¹ The subsequent development is downward, assuming its full shape after the eruption of the permanent teeth. The maximum development is attained between the fifteenth and eighteenth years.

So we find the maxillary antra and ethmoid cells present at birth, while the frontals and sphenoids make their appearance before the third year. Therefore from an anatomic standpoint the sinuses in early life are sufficiently developed to be taken into consideration in pathologic processes.

It is true that they are not always perfectly developed, for even in the adult we know of no structure in the human body which is subject to such wide variations in size, structure, location and development as the accessory sinuses.

In the early years of childhood the upper respiratory tract is particularly susceptible to infection and is generally involved in most of the exanthematous diseases.

In practically every case of measles, whooping cough, diphtheria and scarlet fever, severe reactions are produced in this area. We are always on the alert for ear involvement following these diseases, but do we pay sufficient attention to nasal complications?

The sinuses are lined with mucous membrane similar in structure to that of the eustachian tube, and by the process of continuity can be readily infected.

The numerous recessions and cavities adjoining the nasal fossæ produce an ideal location for the implantation and development of organisms.

If bacteria are placed upon the smooth unobstructed mucous membrane of the mouth we know that they will be eliminated by the normal douching action of the oral secretions as demonstrated by Bloomfield's¹² recent work. However, when they lodge in obstructed crevices like the tonsillar crypts, reduplicated nasal mucous membrane or sinus cavities, they remain for a much longer time.

If the body resistance is below normal, or if the predominating organisms are of a very virulent strain, the defensive action of the tissues may not be able to resist infection. When the sinuses become extensively infected, eradication of the disease is extremely difficult.

Congested nasal mucosa, hypertrophied turbinates, septal deviations, small nasal cavities all interfere with ventilation and drainage, thus prolonging a condition which could be easily eradicated in a more accessible environment.

DIAGNOSIS.

The diagnosis of infected sinuses in children is more difficult than in adults, because subjective symptoms cannot be expressed. In older children, indefinite pains around the head and face with headache may be complained of, although these symptoms are not always present.

The history is very important. It is well to know if the child has had measles, diphtheria, whooping cough and scarlet fever, for White¹³ found thirty-two cases in fifty of his series with infected sinuses who gave a history of childhood diseases. Twenty-nine of these gave a history of whooping cough, three had diphtheria, eight had mumps, while eighteen gave a history of chronic colds.

Onodi¹⁴ tabulated twenty-three cases of the earliest reports of infected sinuses in children and all of these were complications of scarlet fever.

Any chronic cold with nasal discharge should arouse our suspicion of infection in these structures.

Sneezing, headache, irritability and depression are considered very important symptoms by Byfield.¹⁵ Mouth breathing and coughing are also significant signs.

In examination, the nasopharyngoscope is a help, but the procedure is rather difficult. Diagnostic puncture of the antrum with bacteriologic study of the secretion may be resorted to in obscure cases. This procedure has been used successfully by Dean and Armstrong.¹⁶

Transillumination is unreliable, as Skillern¹⁷ points out, and in my own experience has been misleading instead of being of actual diagnostic value.

X-ray examination is our greatest aid, but the plate must be made by a skillful roentgenologist and the interpretation must be correlated with clinical findings.

Any child presenting a majority of the symptoms mentioned or in any case where there is cause to suspect sinus involvement should certainly have the benefit of an X-ray examination.

During the past few years I have had occasion to see a number of cases, young children from three to twelve years of age, who have had their tonsils and adenoids removed without their original symptoms of infection clearing up as had been expected.

They came in for relief of colds, nasal discharge and mouth breathing. Most of them had had their tonsils and adenoids removed from two to three years previous to this examination.

A summary of the important points in the cases presented follows:

REPORT OF CASES.

Case 1.—A. N., age 7, had tonsils and adenoids removed three years ago in order to clear up persistent nasal discharge. As the result of the operation there was some improvement in the symptoms for a while, but the nasal discharge continued. At the present time there is a great deal of thick mucopurulent discharge in each nostril. A quantity of this drains postnasally causing some pharyngeal irritation. The tonsillar fossæ clean and there are no adenoids. Turbinates are congested and enlarged. X-ray examination shows clouding of the antra, also some blurring in the ethmoid cells.

Case 2.—J. M., age $7\frac{1}{2}$, came for the relief of constant nasal discharge. Tonsils and adenoids removed two years ago. At the present time there is no tonsillar tissue remaining, no adenoids found. The infection was confined to the nasal cavity. X-ray examination showed marked clouding of both antra.

Case 3.—E. G., age 7. Tonsils and adenoids removed in 1919. Since operation has had frequent colds and nasal discharge. At the present time there is a great deal of thick mucopurulent postnasal discharge, which produces a great deal of sniffing and coughing. There is no evidence of any remaining tonsil and adenoid tissue. X-ray examination shows definite clouding of both antra and some haziness of ethmoids and frontals.

Case 4.—I. S., age 10, had been treated for chronic rhinitis with constant discharge from right nostril. He gave a history of repeated colds. About two and a half years previous tonsils and adenoids had been removed in an effort to clear up the trouble, but there had been very little relief. Present examination shows a great deal of turgescence of right middle and inferior turbinates. X-ray examination shows clouding of right antrum. After puncturing the antrum and several irrigations the infection cleared up and he has been free of symptoms.

Case 5.—R. L., age 10. Patient was referred for investigation of the sinuses as cause for repeated nasal infections. Two and a half years ago tonsils and adenoids had been removed,

but this had little effect on his nasal infection. X-ray examination shows definite clouding of both antra. There is a great deal of mucopurulent discharge with infiltration of the turbinates and mucous membrane. After a simple puncture of the antra and repeated irrigations the infection cleared up.

Case 6.—R. L., age 6, had tonsils and adenoids removed three and one-half years ago for relief of repeated colds. Since that time there has been very little improvement in the nasal condition. Examination at this time shows marked hypertrophy of turbinates with clouding of both antra. This is confirmed by X-ray examination. No remaining tonsil and adenoid tissue found.

Case 7.—R. S., age 13, was referred for investigation of sinuses as a possible cause for repeated attacks of asthma. Has had these attacks since he was a child. Had resisted all modern methods of treatment. The diet had been carefully investigated, vaccine had been given, tonsils and adenoids removed, but the symptoms would recur. Nasal examination showed a clouding of the left antrum. After puncturing and irrigating this antrum his local nasal symptoms cleared up and he has had no further asthmatic attacks.

Case 8.—C. H., age 6, for the past three years has had intermittent attacks of asthma. Colds have been frequent and there has been considerable nasal discharge. Tonsils and adenoids were removed and an effort was made to clear up the trouble, but there was little improvement in the symptoms. He was referred for nasal treatment. On examination there was marked clouding of left antrum. The right antrum was small and outlines indistinct. Ethmoids were infected and a great deal of enlargement of turbinates.

Case 9.—D. L., age 8, gave a history of repeated colds, a great deal of sneezing and considerable nasal discharge. Tonsils and adenoids had been removed two years previous. Since operation colds have been as frequent, and there has been little improvement in his condition. On examination of the sinuses there was marked clouding of the right antrum. Under local treatment the infection was completely cleared up and the patient has been free from colds for several months.

Case 10.—F. R., age 14, came for relief of repeated attacks of colds. Had tonsils and adenoids removed six years ago. Great deal of mucopurulent discharge in nasopharynx. Examination of nose showed a chronic ethmoid infection and clouding of both antra. Symptoms completely cleared up under local treatment.

TREATMENT.

The simple acute infections of the accessory sinuses in children respond very favorably to treatment. Usually small doses of calomel with a few days' rest in bed is all the general treatment required. Locally, the mucous membrane should be kept clean with some warm cleansing spray of normal saline or dilute Dobell's solution, after which some 20 per cent argyrol should be applied.

The most convenient way to apply this to the nose is to place the child on his back and with an ordinary eyedropper drop from 15 to 20 drops in each nostril. Most of the cases clear up without complications.

In the chronic cases the eradication of the infection is more difficult. If the tonsils and adenoids have not been removed it is advisable to get them out in order to clear up as many foci of infection as possible.

Dean and Armstrong¹⁸ found that 80 per cent of their cases cleared up after the tonsils and adenoids had been removed.

Local treatment consists in keeping the infected surface as clean as possible. Suction is very valuable in this connection, for many crevices can be evacuated which could not be reached otherwise.

Warm saline sprays are very cleansing, soothing and stimulating to the mucous membrane. After this it is helpful to make applications of 2 per cent silver nitrate or 20 per cent argyrol. This should be followed by some emollient spray.

Young children can be best treated in a hospital. The treatment can be carried out much more satisfactorily if the child is away from its parents.

Some cases are helped by the administration of vaccines. A few cases require conservative operative procedures, such as puncture and irrigation of the antra. Only in very exceptional cases is it necessary to do any radical operations.

SUMMARY.

1. All children who have chronic colds with predominant nasal symptoms, such as profuse nasal discharge, stuffiness of the head, mouth breathing and asthmatic attacks, should have a careful investigation of the sinuses.

2. Cases in which tonsils and adenoids have been removed for focal areas of infection, and the symptoms have not cleared up after operation, infection of the accessory sinuses should be suspected.

3. Neglected treatment of early infection of the sinuses in children predisposes to chronic infection which may lay the foundation for serious complications in later life.

4. Nasal colds in children should be treated as an important disease. Careful investigation should be made as to their etiology and diagnosis.

5. The proper treatment of infected sinuses in children gives gratifying results. The general health of the patient is improved. They take on weight, develop more rapidly and give every appearance of being greatly benefited. Most of the cases can be cured by local treatment, for only a small number require operative procedures.

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XXXII.

SOME REMARKS ON NYSTAGMUS.*

By G. W. MACKENZIE, M. D.,

PHILADELPHIA.

When Dr. Skillern, the spokesman for the Program Committee, invited the writer to present a paper before the academy it was suggested that the subject be one the nature of which should appeal to both eye and ear specialists. A further suggestion of the committee was to the effect that a highly technical paper, delving into speculative and fanciful theories, would be less acceptable to the average fellow in attendance than one which adheres more closely to fundamental and established facts. These suggestions were agreeable to the writer. Accordingly, a paper on nystagmus was prepared in which the attempt is made to present the subject in the simplest manner possible, based mostly upon personal observations of a large number of normal individuals, and of others with definitely known pathologic conditions, covering a period of eighteen years.

We can best describe nystagmus as involuntary to and fro movement of the eyes. According to the comparative rapidity of the two opposite movements (to and fro), we may conveniently divide nystagmus into two general forms, the undulatory and the rhythmic. In the undulatory, sometimes called oscillatory, form of nystagmus the to and fro movements occur with equal rapidity, resembling therefore the pendulum movements of a clock. Undulatory nystagmus is most commonly found in individuals suffering from impairment of vision, more especially central vision. The earlier in life the impairment of vision occurs the more prone the individual is to develop nystagmus. The lesion responsible for the visual defect may have occurred during intrauterine life.

*Read before the Academy of Ophthalmology and Otolaryngology, Minneapolis, Sept. 19th, 1922.

The location of the lesion may be in the macula, the maculopapular bundle, or in the ultimate center for central vision.

It is claimed that central opacities of the optical media alone may produce nystagmus. This claim has not been entirely confirmed in the experience of the writer. In the vast majority of cases of corneal opacity we find no evidence of nystagmus. Theoretically the location of the opacity ought to exert some determining influence. For instance, we should be able to find more cases of undulatory nystagmus among those individuals with central than in those with excentral opacities. However, this is not borne out by experience, for we find in the vast majority of cases of central scars of the cornea, even the small dense ones, no sign of nystagmus. The same holds true of anterior and posterior polar cataracts. The size of the opacity appears to exert little influence, for we find quite as many cases of nystagmus among individuals with large as among those with small scars. In spite of this, there remain two apparently inconsistent facts. The first is that undulatory nystagmus is found more commonly among those individuals affected with corneal opacities, together with poor vision, than in those free of these defects. The second is that only a relatively small per cent of the total number of individuals so affected manifest nystagmus. How can these two facts be harmonized and at the same time prove that opacity of the optical media is an actual cause of nystagmus? The answer is that it cannot be done. We must look elsewhere for the cause. The opacity of the optical media is a mere incident and not the cause of the nystagmus. Let us consider the following facts and draw our conclusions accordingly:

(a) The most classical cases of undulatory nystagmus are to be found in those conditions where there is a relative absence through degeneration or otherwise of the retinal pigment in the macular region; for instance, in albinos, coal miners, and cases of central choroiditis.

(b) In cases of diseases of the anterior part of the eyeball, the posterior part is more often diseased than in those cases where the anterior part of the eyeball has remained healthy.

(c) In cases of marked undulatory nystagmus it is decidedly more difficult to make a detailed examination of the eye grounds than in an eyeball that remains stationary.

(d) In those eyes with opacities of the optical media it is more difficult to see the finer details of the fundus than in eyes presenting normally transparent media.

There is but one logical conclusion, and that is, the uveal tract is more often involved in cases of opacity of the cornea than is demonstrable by ophthalmoscopic examination, and undulatory nystagmus is due more to the poor central vision from lack of function of the macula than from the impairment of vision from corneal opacity alone. In other words, the capacity of the cornea is a mere incident and not the sole cause of the nystagmus. It is possible, too, in individuals blinded by any disease of the eye, anterior to the retina, that the lessened amount of illumination reaching the retina causes a relative loss of pigmentation of the retinal epithelium.

Undulatory nystagmus is induced by the futile efforts of the patient to find that sharpest vision, which is possible in normal individuals only when the image of an external object falls upon the macula, which is impossible in the case of one whose macula is for any reason more or less functionless. The failure to accomplish the impossible in spite of repeated efforts to do so over a prolonged period must necessarily result in the development of habitual movements of the eyes in the form of undulatory nystagmus.

Summarizing: Undulatory nystagmus is an involuntary to and fro movement of the eyes. This to and fro movement occurs with equal rapidity. It results from visual defects, especially central. The lesion responsible for the visual defect occurs in early life or even during intrauterine life.

Rhythmic nystagmus, like the undulatory form, is involuntary to and fro movement of the eyes, but unlike the undulatory, and to and fro movement occurs with unequal rapidity; in other words, the movement in one direction is comparatively slow while the return movement is rapid.

In recent years, rhythmic nystagmus has been the subject of considerable study because of its common occurrence in diseases of the so-called vestibular apparatus and its nervous pathways.

Although the writer has described both forms of nystagmus in a broad way as involuntary to and fro movement of the eyes, he wishes to qualify somewhat his earlier statement in

so far as undulatory nystagmus is concerned. Every ophthalmologist can recall the difficulty he has experienced at times in studying the ocular fundi of a patient affected with undulatory nystagmus; furthermore, he can recall how at a properly directed command the patient is able to inhibit somewhat the intensity of the ocular movements for a brief period only (several seconds), when the intensity of the movements again increases up to that which is usual for the particular patient under observation. Thus we see that undulatory nystagmus, although it is involuntary, can be more or less controlled by a strong inhibitory effort on the part of the patient. The ability of the patient to inhibit the intensity of his eye movements in the case of undulatory nystagmus is comparable with the ability of a patient to inhibit the pillrolling movements of the fingers in the case of paralysis agitans. Rhythmic nystagmus, on the contrary, cannot be inhibited by the patient, no matter how strongly he may will to do so.

The eye movements in undulatory nystagmus may occur in any plane—the frontal (torsional), sagittal (vertical), or the horizontal. Besides, these movements may occur in a combination of planes—torsional with horizontal is perhaps the most common of all. Since, in the undulatory form of nystagmus, the to and fro movements occur with equal rapidity, we cannot consistently refer to the direction of the nystagmus; for instance, to the right or to the left, as we can in the case of rhythmic nystagmus.

Rhythmic nystagmus, no matter from what cause, remains true to form under all circumstances. This is not true of the undulatory form, for we find that it is changed to the rhythmic form when the patient attempts in the slightest degree to look in any other direction than straight ahead; especially is this the case if he looks laterally to either side. For instance, if a patient with undulatory nystagmus, the result of a central visual defect, attempts to look to the right, he will manifest a rhythmic nystagmus to the right, which just as readily changes to a rhythmic nystagmus to the left, when he attempts to look to the left. The question naturally arises, why is this so? It is so, for the reason that most, if not all, normal individuals manifest a rhythmic nystagmus to the right, when they look to the extreme right, and a rhythmic nystagmus to the

left, when they look to the extreme left. This rhythmic nystagmus, which is evident in normal individuals, may be horizontal, or mixed horizontal and rotary, or rotary, depending upon how far laterally he directs his vision. It is purely physiologic so long as the intensity of the nystagmus is equal to the two sides for the same degree of angle deviation of the eyes, and disappears when the patient looks straight ahead at infinity.

This physiologic nystagmus exerts a modifying influence in every case of spontaneous nystagmus, undulatory or rhythmic; for instance, we have observed above that the influence of the physiologic element is sufficient to change the character of nystagmus from undulatory to the rhythmic form, and this too by only a moderate effort at side glancing. Again, in the case of spontaneous rhythmic nystagmus, let us say to the right, the slightest attempt to move the eyes to the right is sufficient to increase perceptibly the intensity of the nystagmus to the right, while the slightest attempt to move the eyes to the left will decrease the intensity of the nystagmus to the right. The nystagmus is increased to the right in the case just cited, because there are two influences cooperating to produce nystagmus to the right: the original one that produced the spontaneous nystagmus to the right, plus the physiologic nystagmus or the tendency to the physiologic nystagmus to the right when the patient looks to the right. Rhythmic nystagmus to the right is decreased when the patient looks to the left, because there are two influences operating against one another; the original one that produced the spontaneous nystagmus to the right and the inhibiting influence of the physiologic nystagmus to the left. In some cases, the physiologic influence toward the left when looking to the left is sufficient to neutralize the pathologically induced spontaneous nystagmus to the right, thereby arresting it. This would happen in the case where the pathologically induced spontaneous nystagmus to the right is less pronounced than in the preceding case. In still other cases the influence of the physiologic element toward the left may be sufficient to overbalance the pathologic element toward the right, the result of which is a rhythmic nystagmus to the left, so long as the patient looks intently in that direction. In this case, the pathologically pro-

duced spontaneous nystagmus to the right is minimal in amount but of clinical significance.

Rhythmic nystagmus, like undulatory nystagmus, may occur in any plane or combination of planes, but unlike the undulatory nystagmus, it occurs in a definite direction and is generally designated according to the direction of its quicker component. Thus we may speak consistently of horizontal nystagmus to the left, rotary to the right, etc. To designate it less fully would be insufficient for accuracy. The moment we designate its direction, we at the same time stamp the nystagmus as rhythmic in form, for the simple reason that it is not possible to conceive of any definite direction for undulatory nystagmus, where the two movements occur with equal rapidity. With some beginners there seems to be confusion as to how we should designate the direction of rhythmic nystagmus, due no doubt to the fact as established by Barany that the slow movement of the eyes is the actual vestibular reflex, while the quicker movement is purely voluntary; for instance, if the right labyrinth and nerve are stimulated with the negative pole of the galvanic current, there follows directly a slow movement of the eyes to the left side. So long as the individual being tested is conscious, he experiences a visual sensation of external objects moving slowly to the right. To reorientate himself, he quickly brings his eyes to the right by a voluntary effort originating from an impulse in the cerebral cortex. The continued application of the negative current stimulates the right vestibular nerve; then Deiter's nucleus sends the impulse along the posterior longitudinal bundle to the eye muscle nuclei, causing the eyes again to move slowly to the left, when the brain recognizes the outside world sliding to the right; by an effort of the will, the subject under examination brings his eyes back to their primary position. In short, the slow movement is the actual vestibular reflex and is, therefore, involuntary; while the quick movement is purely voluntary. In designating the direction of rhythmic nystagmus, it is customary to designate it after the direction of the quicker movement, and not according to the direction of the actual reflex movement, as some might prefer.

Rhythmic nystagmus can be produced experimentally in several different ways: (1) By directing the normal indi-

vidual to look to the extreme right or extreme left, referred to earlier and termed physiologic. (2) By placing before the eye a prism base in or out of sufficient strength to throw a strain on one or the other of the horizontally acting eye muscles, when the nystagmus will occur in the plane corresponding to the action of the muscles upon which the strain is placed, the direction of the nystagmus (quicker component) will correspond to the normal action of the same muscle (i. e., toward the apex of the prism). In only a few experiments of this kind are we able to produce a typical rhythmic nystagmus, but in a sufficient number of cases to satisfy the principle. (3) By stimulating the vestibular apparatus and nerve with negative galvanism or by inhibiting the normal tonus with positive galvanism. (4) By producing endolymph impact or movement against the hair cells of the crista ampularis of the semicircular canals, either by the so-called caloric or turning tests.

Furthermore, rhythmic nystagmus may be produced experimentally in a pathologic case; for instance, in a patient afflicted with undulatory nystagmus of ocular origin, the undulatory character of the nystagmus may be changed to the rhythmic form by having the patient look in any other direction than straight ahead, which has already been alluded to.

Rhythmic nystagmus, pure and simple, may result from certain well known pathologic conditions. Rhythmic nystagmus may occur from paresis of any of the extraocular muscles, when it may be accompanied with vertigo. The nystagmus will take place in the same plane and the same direction as the normal action of the weak muscle. The nystagmus reaches its maximum intensity with the maximum effort to use the paretic muscle. Rhythmic nystagmus is never present in such a case when the patient looks in the opposite direction, that is, away from the paretic muscle, and is rarely, if ever, evident when the patient looks straight ahead, which is contrary to that which occurs in the next class of cases.

Rhythmic nystagmus results from pathologic conditions affecting the inner ear or eighth nerve. The character of these conditions is not always the same. They may be conveniently divided into two classes, the irritative and destructive. Again, conditions of a similar kind may differ in degree. For in-

stance, we find irritative conditions in the inner ear, which so far as their effects are concerned, compare with those of stimulation with the cathode. Both tend to produce a rhythmic nystagmus toward the side of irritation or stimulation. The intensity of the resulting nystagmus depends upon the intensity of pathologic irritation or cathodal stimulation. In both instances the resulting nystagmus is not purely horizontal, for the vertical canals are stimulated as well as the horizontal, nor is the nystagmus purely rotary, for the horizontal canal is included with the verticals in the stimulation. The resulting nystagmus from stimulation of all these canals ought to occur in both the horizontal and frontal planes, and in fact it does. In other words, there is a mixed horizontal and rotary nystagmus. If the pathologic irritation is limited to a single canal, we ought to get a single plane nystagmus, and in fact we do, observable in cases of irritative lesions (congestion) of the external semicircular canal, in the early stages of labyrinthine fistula.

In a diffuse destructive lesion of the inner ear, so long as it is of recent origin, there results a rhythmic nystagmus, mixed horizontal and rotary, away from the affected side, comparable with that produced by positive galvanism. In old standing cases (a year or more following the destruction) the spontaneous rhythmic nystagmus that existed early will have disappeared entirely or nearly so. In the circumscribed destructive lesions of recent origin there occurs a spontaneous rhythmic nystagmus away from the side of the lesion, in the plane corresponding to the plane of the canal affected.

Lesions of the vestibular branch of the eighth nerve produce mixed horizontal and rotary nystagmus toward the side of the affection in cases of mild congestion, and away from the side of the lesion in those cases of inflammation sufficiently pronounced as to cause diminution or loss of function. The time limit will not permit me to indulge in this interesting phase of the subject further at this time.

Recently there has been some doubt cast upon the possibility of nystagmus resulting from lesions of the cerebellum. Notwithstanding, I am convinced that nystagmus can occur from a lesion of the cerebellum pure and simple. My reasons are many, but I will content myself with the citation of a

single case at this time. In consultation with Dr. W. H. Sears of Huntingdon, Pa., several years ago, I operated upon a case of left temporosphenoidal lobe abscess, complicated with a left sided labyrinthine suppuration. Dr. Sears, after a most searching examination, diagnosed correctly the labyrinthine suppuration and felt sure as to the presence of an abscess somewhere in the brain, but was inclined to believe the abscess was in the cerebellum.

As a result of the right sided labyrinthine suppuration, the patient manifested before the operation a spontaneous mixed rotary and horizontal nystagmus to the opposite (left) side. At the operation the labyrinth was exenterated and nothing at all was noticed about the behavior of the eyes, the patient being under light narcosis. The cerebellum was then incised in a search for the abscess, when immediately the patient sprung a horizontal nystagmus to the right (operated) side of exceptionally wide excursions. A few minutes later the temporosphenoidal lobe was incised and a large quantity of foul smelling pus was emptied from the abscess cavity, which produced no further effect upon the nystagmus. In brief, the right sided labyrinthine suppuration had caused, as it always does, a rhythmic mixed horizontal and rotary nystagmus toward the opposite (left) side; exenteration of the labyrinth produced no change in the existing nystagmus. Incision of the right cerebellar hemisphere immediately changed the plane and direction of the nystagmus from a mixed horizontal and rotary toward the left to a purely horizontal toward the right. Further operative work in the middle fossa did not influence the character of the nystagmus produced shortly before, by incision of the cerebellum. The irritation produced in the cerebellum by the incision was the clearest evidence to me and those present that a lesion of the cerebellum alone will produce nystagmus; others have observed it, too.

Speaking of nystagmus of cerebellar origin, the writer has observed it to be more frequently purely horizontal, less frequently purely vertical, and least frequently mixed horizontal and rotary. Purely horizontal nystagmus, when of cerebellar origin, points toward a lesion of one of the hemispheres. Since abscess of the cerebellum occurs more frequently in one of the hemispheres than in the middle lobe or vermis, we nat-

usually find horizontal nystagmus to be the prevailing form. In the earliest stages—that is, the period of congestion, when we have signs of irritation, the stimulating effects of the irritation produce horizontal nystagmus toward the side of the lesion: very soon the effects of destruction are felt, when the nystagmus swings over toward the opposite side (away from the side of the lesion); however, so long as the process is limited to one hemisphere the nystagmus retains its horizontal character. In diseases of the vermis alone, for instance, a small circumscribed tumor, the nystagmus is purely vertical. Since abscess of the cerebellum is rarely if ever limited to the vermis, a vertical nystagmus associated with increased intracranial pressure would point toward a tumor rather than an abscess. Rarely does one find a mixed rotary and horizontal nystagmus in abscess or tumor of the cerebellum; when it does occur, it is not due to the lesion in the cerebellum proper but to pressure on the root of the vestibular branch of the eighth nerve or its nuclei; in other words, it is a more or less distant working symptom, in the sense that MacEwen first intended its interpretation.

For the benefit of the eye men, the writer feels that he would like to call attention to the fact that nystagmus can be readily observed during the making of an ophthalmoscopic examination, especially by the direct method. Every now and then one may observe rhythmic nystagmus of the eye at the posterior pole, where its direction is the reverse of what it is at the anterior pole. In all such cases a note should be made of the fact and the case studied more closely with the object of determining its cause.

With one exception I have deliberately avoided the citation of cases, as interesting as they are. My intention has been to carry out as far as possible the wishes of the Program Committee, who feel, as the writer does, that the greatest need is to the greatest number—that it is better to present a simple paper, at the risk of making it kindergarten in style, rather than attempt a more technical one, that might appeal to but a limited few.

1724 SPRUCE ST.

XXXIII.

THE DIAGNOSIS AND TREATMENT OF PULMONARY CONDITIONS THROUGH THE BRONCHOSCOPE.

FROM THE MEDICAL SCHOOL, CREIGHTON UNIVERSITY,
DEPARTMENT OF OTOLARYNGOLOGY.

By B. M. KULLY, M. D.,

OMAHA.

The direct examination of the upper air passages has now been in use a number of years. The direct examination of the larynx was first introduced by Kirstein in 1894. Tracheoscopy, described by Kirstein and Mikulicz, soon followed. In 1897 Killian demonstrated the feasibility of upper bronchoscopy and removed a foreign body from a bronchus. Killian later developed lower bronchoscopy, his achievements earning for himself the title of the "Father of Bronchoscopy." In 1899 Coolidge removed the fragment of a tracheotomy tube from a bronchus. Von Schrötter and Piniasek published their work in 1901, and in 1904 Chevalier Jackson introduced his instruments and initiated his career. Briefly, these are the noteworthy contributions in the early development of bronchoscopy.

The value and use of the bronchoscope in the extraction of foreign bodies from the upper air passages were generally and immediately recognized. Reports of successful removals soon became numerous. The progress and achievements in this particular field are well known and need no discussion. The work of Killian and Bruening in Germany, of Jackson, Lynch, Yankauer and a host of others in this country forms one of the fascinating chapters of medical history.

The bronchoscope, however, has not been generally recognized nor adopted as an important factor in the field of pulmonary diagnosis and therapy. And this, notwithstanding the fact that its use as such is almost as old as is the instrument itself. As early as 1900, Killian¹ presented a paper on the

diagnosis of lung carcinomata with upper bronchoscopy. In 1905 Newmayer reported a bronchoscopy in a case of epithelioma of the lung. In 1906, M. Kob bronchoscoped a case of lung echinococcus. Jackson in 1907 reported an ulceration at the tracheal bifurcation, diagnosed and treated through the tracheoscope. In spite of this pioneer work, development of this phase has been slow. To most of the profession mention of the bronchoscope has always been associated with foreign body work only. It is only in recent years that we have commenced to appreciate the bronchoscope as an asset in the field of pulmonary diagnosis and therapy. The laryngologists as well as the general profession are not sufficiently cognizant of this. As upon the laryngologists must devolve not only the use of this instrument, but the education of the medical profession as to its value, a brief resumé of the work in this field is timely.

Without the aid of the bronchoscope a host of conditions must remain either unrecognized or untreated. Benign and malignant neoplasms and inflammatory processes of various sorts are included in this category. Compression stenosis of the trachea and bronchi indicates bronchoscopic examination as an aid to a proper conception of the condition and a rational method of treatment.

BENIGN NEOPLASMS.

Benign neoplasms, particularly, give rise to a varied clinical picture, for the interpretation of which our present clinical and Roentgen findings are frequently inadequate. Benign tumors of the tracheobronchial tree are rarely discovered except at autopsy. That such conditions can be recognized and treated through the bronchoscope is evidenced by the increasing number of case reports. Tilley³ has reported the diagnosis and removal of an intratracheal tumor by peroral endoscopy. Horne⁴ has reported a papilloma of the bifurcation of the trachea. The writer has seen a pedunculated fibroma completely filling the left main bronchus. This patient presented the classical symptoms of empyema and was repeatedly aspirated for such with negative results. The tumor was removed endoscopically by S. Yankauer, and after a few lung irrigations the patient made a complete recovery.

MALIGNANT NEOPLASMS.

Malignant neoplasms offer another important field for the bronchoscope. Diagnosis by other means is frequently mistaken or delayed. Funk⁵ calls attention to the fact that malignant disease is often mistaken for tuberculosis. It has been our experience that it is often associated with and masked by chronic pulmonary suppuration. In a series of ninety-two cases of pulmonary suppuration bronchoscoped at Mt. Sinai Hospital, New York, there were discovered six previously unsuspected malignant neoplasms. If the growth originates in or has invaded the bronchus it can be recognized through the bronchoscope, and it is usually possible to remove a section for microscopic examination. The treatment of malignancy of the lung by any method is, of course, unsatisfactory. Radium therapy can be made more effective, however, by introducing the radium capsule directly into the growth through the bronchoscope.

CHRONIC PULMONARY SUPPURATION.

In recent years the direct examination has been increasingly used in a number of inflammatory conditions. A great deal of work has been done, particularly in the treatment of chronic pulmonary suppuration. Chronic pulmonary suppuration, including lung abscess, bronchiectasis and gangrene, has long been one of medicine's failures. With few isolated exceptions, medical and surgical treatment has been of no avail. Bronchoscopy offers a direct and logical method for coping with the condition. The method as first introduced by Yankauer in 1916 is as follows: The bronchoscope is introduced into the suppurative focus or into the bronchus, draining it, and by means of a double current canula fluid is injected and aspirated. Continuous irrigation and aspiration are maintained until the solution returns clear. If more than one lobe is involved, the process is repeated in each involved lobe. The irrigating fluid may be normal saline or one containing an antiseptic. Weak iodine solutions have usually been used, but at present we are using a solution of potassium permanganate. In addition to the irrigation, all conditions preventing adequate drainage are treated. Cicatricial stenoses of the draining

bronchi are dilated. Granulation tissue is cauterized or removed.

The procedure is not a very trying one. The patients report to the hospital, are bronchoscoped and irrigated and are discharged the same day. They are able to resume their work the following day.

Considering the almost hopeless pathologic condition, the results have been excellent. The profuse, purulent expectoration and the fetid odor can usually be controlled. In a series of twenty-nine cases which the writer⁶ reported last year, there were four clinical cures, nineteen others were sufficiently improved to be able to resume their respective occupations and places in society. Some of the patients received over one hundred and fifty bronchoscopic irrigations without a single severe reaction in the entire series.

OTHER INFLAMMATORY CONDITIONS.

Syphilis of the lung does not ordinarily require endoscopic interference. It is interesting to note, however, that as early as 1905 A. Reinhard⁷ published the bronchoscopic findings in a case of syphilis of the lower air passages. Luetic cicatrices of the trachea and bronchi do occur and may urgently require direct treatment. The writer has repeatedly dilated a luetic stricture of the trachea that was causing intense dyspnea.

Investigations of the trachea and bronchi have been made in diphtheritic and postdiphtheritic conditions. Lynch has reported and treated pulmonary suppuration in association with postdiphtheritic bronchial stenosis. Recently Purcell and Acree⁸ have reported a case of diphtheritic tracheitis and bronchitis which required repeated bronchoscopic removal of the membrane for the relief of dyspnea.

Simple ulcers of the trachea and bronchi as reported by Jackson in 1907 have repeatedly been found and treated by direct application. Herein may lie the explanation and the treatment for some of our inexplicable chronic coughs.

An attempt has also been made to treat asthma by direct application through the tracheoscope, and a few successful results have been reported. Knowing the uncertainty and vagaries of the disease and its tendency to disappear at times, the results are far from conclusive.

TRACHEOBRONCHIAL COMPRESSION.

Tracheobronchial stenosis from external compression indicates direct examination. Important information as to diagnosis and indications for treatment is frequently obtained. Frazer⁹ calls attention to the importance of the position of the trachea in intrathoracic disease. In a case of thoracic dermoid operated upon and recently reported by Lilienthal, the bronchoscopic finding was an important factor in establishing the preoperative diagnosis. As dermoid cysts are situated in the anterior mediastinum the tracheal compression was from in front. Congenital stridor in infants is usually due to a compression of the trachea by an enlarged thymus, but may be due to laryngeal conditions, such as papillomata, angiomata, etc. The diagnosis can be made by direct examination. The bronchoscope has at times proved an invaluable aid in the diagnosis of compression due to aneurysm, malignancy of the mediastinum and of the esophagus and interlobar empyemata.

INSUFFLATION OF OPAQUE SUBSTANCES AS AN AID TO ROENTGEN DIAGNOSIS.

Investigation of the tracheobronchial tree with the X-ray after the injection of opaque materials is still in the experimental stage. Considerable evidence has been adduced, however. Jackson¹⁰ reports that insufflation of dry bismuth subcarbonate produced no symptoms, mapped out the bronchial tree completely and disappeared in twenty-four hours. Bullowa and Gottlieb,¹¹ working with dogs, have also reported a rapid disappearance of the opaque material and believe that the bronchial musculature has a peristaltic action. It is possible by this method to map out lung abscess and bronchiectatic cavities. The Roentgen investigation of the lungs by this method is still in the embryonic stage. It may or may not develop into a valuable asset in the field of pulmonary diagnosis.

CONCLUSION.

The bronchoscopic investigation and treatment of the conditions herein mentioned is of course valuable and in many instances essential. More important, however, is the realization of the field which is opened up and the possibilities it

holds. The indications for its use should be remembered. Every case presenting persistent obscure lung signs warrants bronchoscopic investigation. The method is still in its incipency. We believe that it is destined to expand into one of vast usefulness. Sufficient has already been accomplished, however, to have proved it invaluable in the handling of hitherto unrecognized and untreated pulmonary conditions.

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XXXIV.

THE STRUCTURE AND FUNCTION OF THE CRISTA
AMPULARIS.*

BY GEORGE E. SHAMBAUGH, M. D.,

CHICAGO.

Because the reactions in the labyrinth which result in a stimulation of the end organs are physical reactions, it is obvious that any effort to analyze these reactions must be based on as accurate a knowledge of the structures of these end organs as it is possible to gain. Such a knowledge can be acquired only by the study of a series of actual preparations. It cannot be gathered from descriptions or from illustrations.

To one who has acquired from the study of actual preparations an appreciation of the complicated, delicate mechanism in the membranous labyrinth, certain facts become at once apparent. One is that conclusions drawn from the making of models are of very limited value, for the reason that it is quite impossible to construct models which have any but the remotest resemblance to the delicate, complicated structure in the membranous labyrinth. Another is that experiments based on the results of operation on the several parts of the internal ear of lower animals are of but relatively little assistance in our attempt to analyze the normal reactions resulting in a stimulation of these end organs, for the obvious reason that no operation of this sort can be carried out without causing the escape of the labyrinth fluids and thus necessarily putting an end at once to any and all of those delicate reactions which bring about the normal stimulation. The final conclusion forced upon one who has acquired an appreciation of the delicate structures in the labyrinth is that our main reliance for an explanation of the reactions in the labyrinth resulting in a stimulation of its end organs rests upon experiments on the human. We are fortunate in being able to carry out a large

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series of experiments without in any way harming the individual.

In our attempt to analyze the reactions in the internal ear it is highly important that we avoid as far as possible any intricate explanations and keep the whole discussion as simple as possible, for it is only in this way that progress is made. One thing is certain, there is no point to be raised in this discussion that does not open the door for endless arguments. The conclusion that approaches more nearly the correct explanation is the one which accounts readily for most of the phenomena.

Then followed a lantern demonstration of the minute anatomy of the end organs in the semicircular canals, and the reason was pointed out for concluding that the cupola constituted a fixed cap on the crista not capable of displacement, which means that the interaction between the cupola and the hair cells of the crista continues only so long as the endolymph current lasts and no longer.

The discussion began with the phenomena resulting from the rotation experiment. These phenomena of rotation may be stated briefly as follows: On starting rotation, say to the right, the individual in the upright position experiences the sensation of being rotated to the right, and a horizontal nystagmus with the quick component to the right develops; both of these persist for a few seconds and then disappear and remain absent, no matter how long the turning is kept up, provided there is no acceleration or retardation in the speed of rotation. On stopping the rotation the individual experiences the sensation of again being rotated, but this time to the left, and there develops a nystagmus towards the left. These phenomena persist for perhaps 20 seconds before they die out. That these phenomena are the result of the movement of the endolymph in the horizontal canals is questioned by no one. Three explanations of the reactions producing these phenomena are offered.

Breuer believes that but a momentary impulse to the endolymph can result from inertia of this fluid, both on starting and on stopping rotation, before this motion is overcome by the friction of the fluid on the walls of the very minute membranous canal. He accounts for the persistence of the phe-

nomena by assuming that this momentary impulse impinging on the cupola displaces this structure on the crista. The resulting stimulation of the hair cells and the phenomena resulting from this stimulation persists until the cupola has been drawn back to its normal position. Barany also accepts but a momentary impulse to the endolymph, but accounts for the persistence of the phenomena on the assumption that this momentary impulse on starting and stopping rotation explodes so-called nystagmus centers, one producing nystagmus towards one side, the other to the opposite side. These centers contain stored energy which requires just so long to expend itself. The other explanation is that the inertia of the endolymph persists both on starting and stopping rotation for some seconds, and the duration of the stimulation of the hair cells is the same as the duration of the endolymph current and equals the duration of the phenomena resulting from starting and stopping rotation.

The three hypotheses may be expressed graphically as follows:

1. Duration of endolymph current < duration of peripheral stimulation = duration of nystagmus (Breuer).
2. Duration of endolymph current = duration of peripheral stimulation < duration of nystagmus (Barany).
3. Duration of endolymph current = duration of peripheral stimulation = duration of nystagmus.

Of these three hypotheses the only one that offers a plausible explanation of the phenomena, not only of the rotation experiment but of the other experiments to be discussed later, namely, the Ewald experiment, the caloric experiment and fistula cases, as well as the explanation of the tonus itself, is the one which makes the duration of the endolymph current, the peripheral stimulation and the nystagmus all equal. How this is so will be pointed out when discussing the several experiments.

The question at once arises about the objection to the theory of endolymph currents on account of the minute caliber of the membranous canals. This objection has become formidable chiefly because of the failure to grasp fully the several forces taking part in the movement of endolymph in the canals resulting from inertia. These objections have been based on the

minute caliber of the membranous tubes, as though the caliber of these tubes was the only factor to be considered. As a matter of fact, it seems extremely probable that the inertia of the endolymph in the membranous canals has little, if any, bearing on the duration of the endolymph in the canals resulting from the rotation experiment. The main factor in continuing the endolymph current is the inertia transmitted to the fluids of the much larger channels of the osseous canals and particularly to the fluids in the vestibule itself. These fluids are as certainly affected by the rotation as is the endolymph in the membranous canals, and the movement of the fluid in these much more roomy spaces by pressure on the membranous structures forces the endolymph to continue moving. With this fact in mind it seems much easier to accept the last formula, which alone explains all the phenomena, than either of the other hypotheses which, as we shall show, offer no plausible explanation for much of the phenomena.

Ewald's experiment, which produced a measured movement in each direction for the several canals, brought out several facts of fundamental importance in the physiology of these structures. The first is that an endolymph current in a particular canal produced forced movements, head motion, nystagmus, only in the plane of that canal. The second is that the movement of the head or the slow motion of the nystagmus is always in the direction from right to left, or from left to right of the endolymph current. A third fact brought out by his experiment was that in each canal a stronger response was elicited by an endolymph current in one direction from that caused by a current in the opposite direction and that the greater response in each canal was always from those currents which produced movements toward the opposite side. This last fact furnishes the explanation why the tonus from the right ear when not checked by the tonus from the other side always produces movements to the left and vice versa. This will be brought out more clearly in the discussion of tonus.

The Fistula Phenomena.—In chronic suppurative otitis media it is not uncommon for an erosion to take place through the bony capsule of the labyrinth, usually the horizontal canal. In such cases it is possible by compression and rarefaction of air in the external meatus to reproduce the Ewald experi-

ment. In both the Ewald experiment and in fistula cases it has been found that the duration of the phenomena resulting from the movement of the endolymph is exactly the same as is the endolymph movement. Some years ago I saw a patient where on one side there was a dead labyrinth, the result of an old suppurative labyrinthitis, and in the remaining ear there was a fistula in the horizontal canal. In this ear there was fortunately a complete closure of the eustachian tube. The situation was particularly suited for regulating the compression of air in the external meatus and for observing the resulting phenomena without any question of interference from the tonus from the opposite ear. I examined this case a great many times, using a bulb which completely closed the external meatus and a suitable cut off from a compressed air apparatus: I found that the nystagmus resulting from compression always lasted exactly as long as did the compression. In this case with the air pressure employed, it always took about ten seconds for the complete collapse of the membranous canal, for at that moment the nystagmus always stopped. Now when the compression was kept up a shorter time and then held, at that moment the nystagmus also ceased. The only explanation for this phenomenon is that the stimulation of the hair cells continues only so long as the actual movement of the endolymph lasts, and the resulting nystagmus continues only so long as the peripheral stimulation continues. With either the Breuer or the Barany hypothesis we should expect the nystagmus to continue for a definite time after the cessation of the compression—that is, after the cessation of the endolymph current. In the first instance, because of the displacement in the cupola, and in the second, because of the expenditure of stored energy in nystagmus centers.

The Caloric Experiment.—Barany found that by chilling or warming the outer wall of the labyrinth, endolymph could be made to flow in either direction in the two canals which lie close to the middle ear chambers, the superior and the horizontal canals. In the upright position the superior canal lies in the vertical plane and permits of endolymph currents from caloric stimulation, while the horizontal canal, lying on the horizontal plane, no such movements are possible. On tipping the head either forward or backward, the horizontal canal

comes in the perpendicular plane and the superior lies horizontally. Now it is in the horizontal canal in which endolymph current is possible from caloric stimulation. As long as the superior canal alone was perpendicular a purely rotating nystagmus developed, and when the horizontal canal alone was perpendicular a purely horizontal nystagmus results. When the position of the head was such that both canals were partially in the perpendicular plane, a mixed rotating and horizontal nystagmus results. These are exactly the results we are prepared to expect from the facts brought out in the Ewald experiments. Now the interesting fact is this, that the nystagmus produced by the head in the upright position stops the moment when this canal is placed in the horizontal plane, that is the exact moment the endolymph current ceases. With both the Breuer or the Barany hypotheses this could not take place.

In all of these experiments there is but one explanation possible—that is, that the duration of the stimulation and the resulting nystagmus equals the duration of the endolymph current. Confronted by this accumulated evidence regarding the existence and duration of endolymph currents, I find myself unable to take seriously the theoretical objections based upon the opinion of physicists who have considered only the caliber of the semicircular canals.

Labyrinth Tonus.—If I were asked what in view of our clinical experiences I would consider as the important role of the vestibular mechanism, I would unhesitatingly say a mechanism of equilibration, which is accomplished by virtue of tonus impulses which are constantly emanating from the labyrinth to supply the skeletal muscles. It seems quite probable that the end organs in the vestibule, the macula acustica, take part in supplying this tonus, but there is every reason for believing that the crista ampularis plays the more important role in producing this tonus.

Several explanations have been offered for the origin of labyrinth tonus. Ewald assumed that the hair cells of the crista were in a state of ciliary motion, which constituted a constant stimulation of the hair cells. This is of course impossible, since these hairs do not project free in the endolymph but are covered by the cupola. Breuer assumed the existence of endo-

lymph currents from the stria vascularis where it is secreted out through the aqueductus vestibuli to the cerebrospinal fluid. This hypothesis is also impossible on anatomic grounds. Barany placed this tonus in tonus centers which was replenished from the labyrinth, but he did not explain how. Now it has been apparent to all of these men that all that is required to account for the flow of tonus from the labyrinth is a constant, however mild, stimulation of the hair cells of the cristæ. Now the normal stimulation of the crista is the result of endolymph movements against the sides of the cupola. It seemed to me quite probable that this motion of the endolymph could be the result of the to and fro movements imparted to the fluid from the pulsation in the labyrinth artery. I advanced this explanation when I first published my conclusion regarding the function of the semicircular canals in 1912. Clinical evidence all points to this as the correct explanation of the origin of labyrinth tonus. I shall not enter into this now, suffice it to say that Barany now accepts this explanation and has published clinical observations justifying this hypothesis. These pulsations in the endolymph stimulate equally the hair cells on both sides of each crista. We have seen, however, that the greater response in each canal results from the stimulation of those endolymph currents which produce movements towards the opposite side. From the right labyrinth arise tonus to those muscles producing movements towards the right as well as toward the left, but the stronger impulses are those which produce movements toward the left. The tonus for the two sides exactly balance each other and a state of equilibrium results. An increase or a decrease in the tonus from one side would upset this equilibrium and result in vertigo. This is observed in its most pronounced form for the sudden destruction of one labyrinth. Now the tonus from the opposite normal ear throws the patient toward the diseased side and a violent rotating nystagmus develops, with the pull or slow component towards the diseased side. How compensation is restored and equilibrium reestablished cannot be discussed here.

Phenomena of Fatigue.—Under this heading I shall discuss three sets of phenomena resulting from the rotation experiment. The first is the facts brought out by the early work of

Barany, namely, that the maximum nystagmus following rotation develops after approximately ten rotations and that a shorter nystagmus develops either after a shorter or longer rotation. This phenomenon finds a ready explanation as a phenomenon of fatigue, if our hypothesis is correct, regarding the duration of the endolymph currents on starting and stopping rotation. The explanation is as follows: In the rotation experiment we recognize a much more violent stimulation of the end organs than we meet with in our daily experience. It is to be expected therefore that phenomena of fatigue might appear. When we rotate a patient toward the right there develops a nystagmus toward the right caused by the inertia of the endolymph, and this nystagmus continues so long as does the peripheral stimulation—that is, for approximately ten rotations. If now we stop rotation at the moment when the peripheral stimulation occasioned by the rotation ceases, we will get the maximum after response, for the reason that impulses emanating from the opposing groups of hair cells, on stopping rotation which produce nystagmus to the left, are not impeded by tonus from the hair cells stimulated during rotation, since these are in a state of fatigue. Suppose that the turning is stopped after but five rotations—that is, before the maximum stimulation has been developed from these hair cells actively stimulated during the turning, then the after nystagmus must be weakened because of the opposing tonus from those cells stimulated during rotation but which are not as much exhausted as they must be after ten rotations. Suppose again that instead of stopping at the end of ten rotations—that is, at the moment when the peripheral stimulation ceases—we continue the turning for 50 or 100 rotations, during all this time there will be no stimulation of the hair cells going on, for the reason that the endolymph is moving as fast as the canals. During all this extreme rotation the hair cells stimulated during the first ten rotations are recovering from their fatigue. The result will be the same as after five rotations, a shortened after nystagmus.

The second phenomenon of fatigue is the following: It has been observed that the moment the nystagmus which developed during rotation ceased, there may develop for a few moments a nystagmus towards the opposite side, although the

turning is going on at the same pace. The explanation as a phenomenon of fatigue is quite apparent. At the moment the nystagmus created by active rotation ceases, that moment the endolymph current also ceases, and the tonus from the hair cells which would be stimulated on stopping rotation outbalance for a few moments the tonus for those cells actively stimulated during rotation; the result will be the development of a nystagmus towards the opposite side exactly as though the rate of rotation had diminished or the turning had been stopped entirely.

There is still one other rather interesting phenomenon, the explanation of which comes in the same category as the phenomena of fatigue from overstimulation of the peripheral mechanism. This is a phenomenon described by Barany in his earlier observations on vestibular stimulation. He found that in individuals, where the response was particularly acute, that if, instead of stopping the turning at the end of ten rotations the turning was kept up for a considerable period—that is, for 50 or 100 rotations—that on stopping rotation the following phenomenon developed: First an after nystagmus of shorter duration than that which would result had the turning been stopped at the end of ten rotations. At the moment when this after after-nystagmus ceased there developed for a few moments an after nystagmus directed toward the side toward which the patient had been turned. Applying the same principles just gone over, the explanation as a phenomenon of fatigue is clear. In the first place, all we need to assume is that the active stimulation of the hair cells causing a nystagmus toward the same side as the rotation ceases after approximately ten rotations. Now the rotation is continued long enough to permit of a complete recovery from the fatigue occasioned by the violent active stimulation during rotation; then on stopping rotation the response elicited by the stimulation of the opposite group of hair cells producing nystagmus toward the opposite side will be somewhat weakened because of the vigorous tonus from those cells which were stimulated during rotation but which had been given ample time for recovery before the rotation was stopped. In exactly the same way those cells stimulated by the inertia of the endolymph on stopping rotation are being vigorously overstimulated, so

that when the after nystagmus ceases—that is, when the endolymph movement entirely disappears—these cells are in a state of fatigue so that the vigorous tonus from the opposing group of cells, lacking for a few moments the balance from the opposite groups of cells, now produce the phenomenon of after after-nystagmus as described by Barany. This explanation may on first thought seem a little involved, but it is in reality extremely simple, and it appears to be involved only because of the roundabout method which one must use in describing the several reactions. A graphic representation of the two horizontal canals shows the thing very quickly and with great simplicity.

A NEW MAGNIFYING GLASS FOR OTOSCOPY.

BY ALEXANDER ZEBROWSKI, M. D.,

NEW YORK.

The need of obtaining clear and at the same time magnified otoscopic pictures was felt at the very beginning of otoscopy. In the year 1873 Trautmann¹ described the manner by which a common magnifying glass (a biconvex lens) can be used for otoscopy. For this purpose Trautmann screwed the lens into the ear speculum, changing, when necessary, both the glass and the speculum. Still earlier, in the year 1823, the magnifying glass had been used by many otologists, among others Deleau and Buchanan. Bonnafont (1834) used a compound magnifying glass of three lenses.

Afterwards Broeck, Cleland, Weber-Liel and others used a lens.² Politzer³ and Brühl⁴ advocate the use of a lens for otoscopy, and both emphasize the great importance of obtaining clear, distinct otoscopic pictures. Well known is a lens of Brünings by means of which we can very easily get a magnified view of the drum and of all possible pathologic changes in the latter. Brünings' lens is of great advantage, especially for beginners and for the otoscopy of normal drum membranes.

To my knowledge the latest magnifying glass described and recommended for our profession is an apparatus of Prof. Dr. Demetriades of Athens (Greece),⁵ consisting of a metallic lug on which are placed two metallic grooves. One groove is for the lens, the other for the ear speculum. The lens has a triangular opening which enables the use of a probe and little surgical instruments while looking through the magnifying glass.

In the year 1918, at the session of the Austrian Otological Society,⁶ I demonstrated an ear magnifying glass which for three years I used continually in otoscopy, and which has rendered me valuable services. My magnifying glass differs from the others, because it is not placed in the aperture of the reflector or on the ear speculum, but is attached by means of a

half ring to the first phalanx of the left thumb (Fig. 1). By means of a double joint the magnifying glass can be turned in every direction. The lens can be easily removed from the metallic groove and replaced by the other. We can use the lenses with all possible focal distances. I give the focal distances of the lenses which can be used for otoscopy:

Diopters	Focal distance
13 D.....	77 mm.
12 D.....	83 mm.
11 D.....	90 mm.
10 D.....	100 mm.

Personally the most suitable lens for my eye is 11 D. focal distance 90 mm. The lens is not round, but on one side a segment has been cut away (Fig. 2). It does not interfere with obtaining magnified otoscopic pictures, but enables the aurist (besides the use of the probe) to perform under the control of a lens several small operations (irrigation of the attic, intratympanic otoscopy, removal of small polyps, granulations, etc.). In the after treatment of the radical mastoid operation the magnifying glass can be very useful, because it makes it impossible to overlook exuberant granulations, diseased areas of the bone and accumulations of even the smallest quantity of pus. The discovery and treatment sometimes of small and hidden perforations in the Shrapnell membrane becomes much easier with the use of a lens than with the naked eye.

The magnifying glass described has been made by Reiner⁷ (Vienna) and is to be obtained there.

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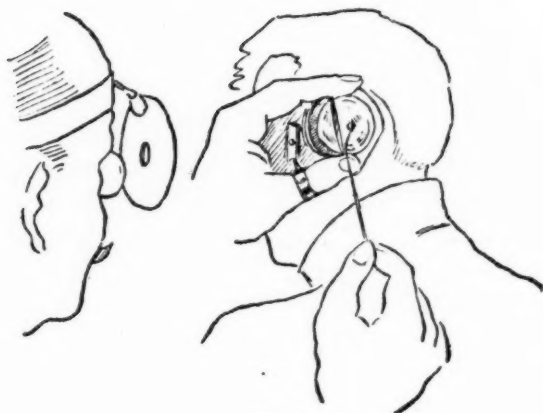


Fig. 1.

Magnifying glass in position. Use of the probe.

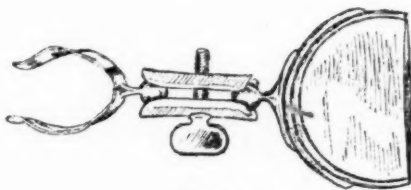
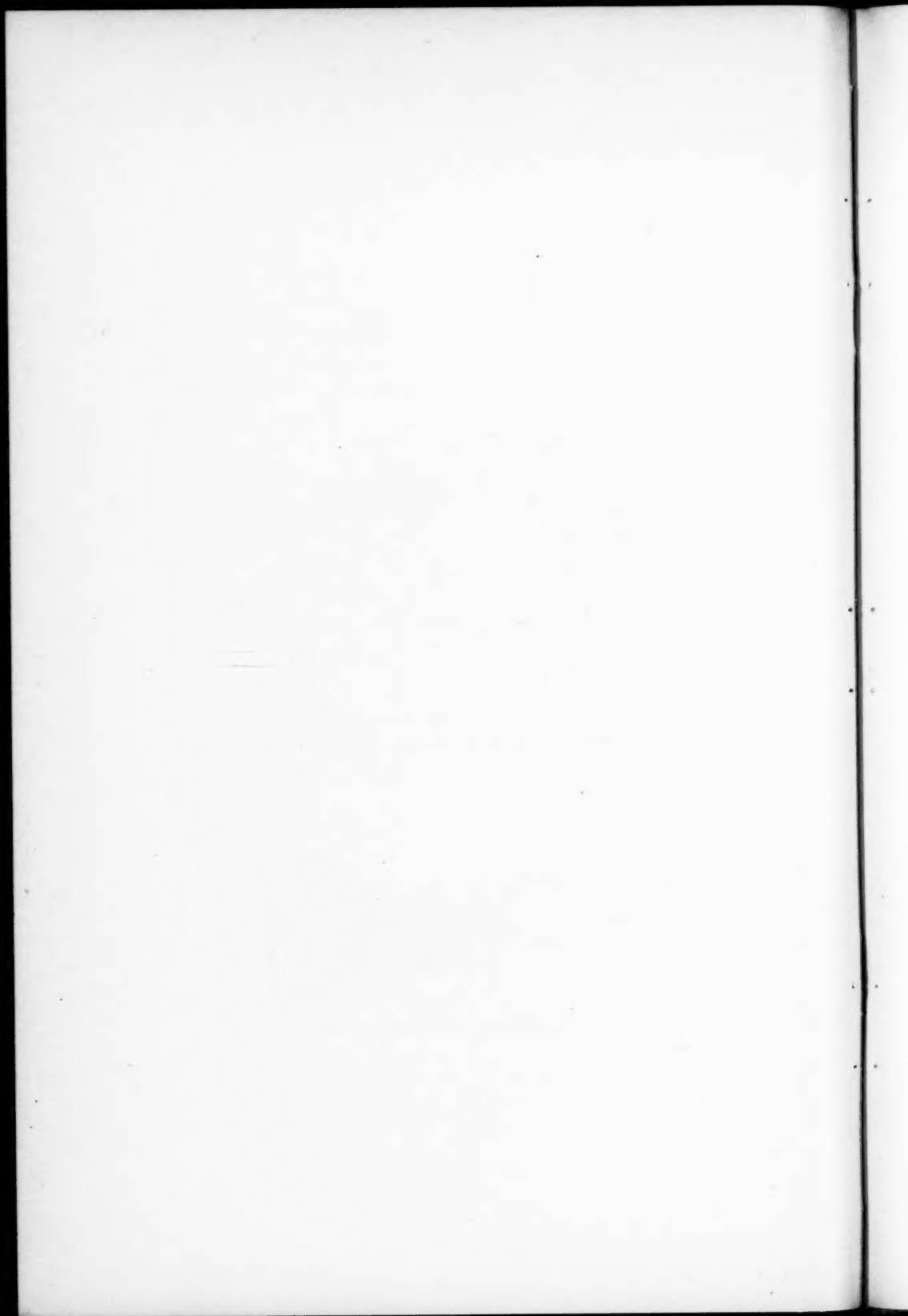


Fig. 2.

Magnifying glass. Double joint.



XXXVI.

OTITIS MEDIA COMPLICATING OPERATIONS ON
THE GASSERIAN GANGLION.

By H. R. LYONS, M. D.,

ROCHESTER, MINN.

Otitis media complicating operations on the gasserian ganglion was first observed in the Mayo Clinic about three years ago, in a patient who complained of a sense of fullness and deafness, following section of the posterior root of the gasserian ganglion for trifacial neuralgia. Since then such observations have been made several times. This type of otitis media occurs from a few days to several weeks after operation on the gasserian ganglion. The chief complaint is a sense of fullness and deafness on the side on which the operation is performed. Otalgia is never severe and is not a common complaint. Examination of the ears discloses a fullness in the inferior quadrants of the tympanic membrane, with more or less obliteration of the common landmarks. There is usually a fluid level, and a bubbling sound is heard with inflation of the eustachian tube. Two patients said that they had "water in the ear." The tympanic membranes were pale in each instance. In this condition there also appear within the middle ear bleblike formations without evidences that the remainder of the cavity contains fluid. The tympanic membrane is gray or pink and does not contain generalized fluid. It is flaccid or atrophic in appearance, is not intensely red, and never has the sense of resistance with the otoscope. Deafness, as tested by tuning forks, was of the conduction type and not severe. The posterior superior wall of the canal did not droop.

In classifying the pathologic conditions in the middle ear in cases of otitis media, the question arises whether the fluid is exudate or transudate. Because of the close association and connections of the tympanic plexus in the mucous membrane of the middle ear with the branches from the gasserian ganglion, as described here, it is definitely established that the fluid is the result of an altered condition of the mucous mem-

brane consequent to the operation. It is accepted that the operation results in a trophic disturbance in the mucous membrane of the middle ear, causing the collection of fluid. I believe that this type of otitis media is due to the secretion of the fluid, but the point cannot be definitely established. Animal experimentation as a means of investigation might have been feasible, except that the results of section of the posterior root of the gasserian ganglion in animals not suffering from trifacial neuralgia would not be parallel to those following a similar operation on patients with a definite disturbance of the sensory root, or of the gasserian ganglion, as in the cases here reported. It was therefore concluded that such investigation would not be of value.

In one case observed (Case 1), secretory otitis media followed alcohol injection of the posterior root of the ganglia. Spontaneous rupture and secondary infection, resulting in suppurative otitis media, occurred. It is also of interest that the posterior root was injected, since the neuralgia disappeared at once and cutaneous anesthesia followed.

In another case of secretory otitis media, not reported because the condition occurred several weeks after the patient went home and our information was not definite, suppuration occurred, but cleared up promptly. This man had a corneal ulcer, as did one other patient.

Abrasions of the cornea are not uncommon following operations on the gasserian ganglion; two of this series of patients had corneal ulcers. I am unable to determine whether such ulcers are due to trauma or purely to trophic local changes. Both causes may exist and possibly a combination of the two, namely, lowered local resistance due to the trophic changes, with subsequent trauma from dust and other foreign materials. Although goggles of the automobile type are worn by such patients postoperatively, trauma cannot be ruled out definitely.

In many respects the picture of otitis media, due to trophic disturbances following gasserian ganglion operations, simulates herpes zoster otiticus, differing chiefly, however, in that pain is absent in the former and severe in the latter; also the bleb formations on the pinna are absent in this form of otitis media.

NERVE CONNECTIONS.

Sensory and trophic nerve supply to the mucous membrane of the middle ear is abundant and is directly connected with the sensory root of the gasserian ganglion. The tympanic plexus in the middle ear also has direct connection with the posterior root of the fifth cranial nerve, the sphenopalatine ganglion, and the cervical sympathetic nerves.

The sensory nerves to the external auditory canal are derived from the auriculotemporal branch of the trigeminus and from the auricular branch of the pneumogastric. The latter, also known as Arnold's nerve, perforates the wall of the meatus and supplies its lining membrane.

The posterior wall is separated from the mastoid process by the tympanomastoid fissure. The auricular branch of the pneumogastric nerve passes through this fissure to the posterior wall of the canal. The coughing, sneezing or vomiting that sometimes follows irritation of the canal, as from cleaning the ear or examining it with instruments, is said to be due to a reflex effect on the pneumogastric nerve through this branch. The auriculotemporal branch of the trigeminus nerve enters into its supply and may explain the earache in cases of cancer of the tongue or disease of the lower teeth.

The nerve supply of the tympanic membrane is derived chiefly from the auriculotemporal branch, supplemented by twigs from the tympanic plexus and by the auricular branch of the vagus. They accompany, for the most part, the blood vessels and, besides supplying the latter, form a subcutaneous and a submucous plexus. The tensor tympani and tensor palati muscles receive their nerve supply from the same source, namely, the trigeminus, through the otic ganglion.

The nerves supplying the mucous membrane of the tympanum are branches from the tympanic plexus formed by the tympanic branch of the glossopharyngeal nerve, in conjunction with sympathetic filaments from the network accompanying the carotid artery. The tensor tympani muscle receives its supply from the trigeminus, the stapedius from the facial. Although the chorda tympani nerve has an intimate topographic relation to the space which it traverses close to the outer wall, it gives no filaments to the structures within the

tympanum. The nerves of the eustachian tube are supplied from the tympanic plexus and from the pharyngeal branches of the sphenopalatine ganglion.

The tympanic nerve, or Jacobson's nerve, arises from the petrous ganglion and traverses a tiny canal in the osseous bridge between the jugular fossa and the carotid canal. Entering the tympanic cavity and receiving fibers from the carotid plexus of the sympathetic by way of the small deep petrosal, the tympanic nerve passes upward and forward in a groove on the promontory and breaks up in this situation to form the tympanic plexus. After distributing filaments to the mucous membrane lining, the tympanic cavity and the associated air spaces (mastoid cells and eustachian tube), its fibers re-assemble and join with a filament from the geniculate ganglion to continue as the small superficial petrosal nerve to the otic ganglion.

The branches of the tympanic nerve are: The small superficial petrosal nerve, the branch to the fenestra ovalis, the branch to the fenestra rotunda, the branch to the eustachian tube, the branch to the mastoid cells, and the branch to the great superficial petrosal nerve.

The auricular branch of the vagus is given off from the ganglion of the root. It receives a filament of communication from the petrous ganglion of the ninth nerve and follows the outer margin of the jugular foramen to an opening between the stylo-mastoid and jugular foramina. Entering this foramen, it traverses a canal in the temporal bone which crosses the inner side of the facial canal and terminates between the mastoid process and the external auditory meatus. Leaving the canal, the nerve supplies the skin of the posterior part of the auricle and of the posterior inferior portion of the external auditory meatus. While traversing the temporal bone, the auricular nerve communicates with the facial and, after reaching its arc of distribution, with the posterior auricular nerve.

The communicating branch of the facial nerve to the tympanic plexus traverses a tiny canal in the temporal bone to reach the tympanic cavity where it joins the main continuation of the tympanic plexus of the glossopharyngeal to form the small superficial petrosal and proceeds to the otic ganglion, which it enters, as a sensory root. The fibers from the tym-

panic plexus, probably secretory in function, are distributed from the otic ganglion to the parotid gland.

REPORT OF CASES.

Case 1 (A398947).—Mr. S. A. H., aged forty-eight years, came to the clinic complaining of severe pain throughout the left side of his face, which was recognized as trifacial neuralgia. July 28, 1922, the patient was relieved by a preliminary alcohol injection of the sensory root of the fifth cranial nerve. He returned in about two weeks because he had a recurrence of the severe pain. Examination of his ears was negative. August 10, a gasserian ganglion operation was performed on the left side, the posterior root being cut. Three days after operation the patient complained that his left ear felt full; this feeling persisted, with slight deafness.

Examination showed the right ear to be normal; the left tympanic membrane was pale, the lower quadrants bulging and the upper normal. Motion of the tympanic membrane with an otoscope confirmed the patient's suspicion that there was water in his ear, because the fluid could be seen to move. Changing the position of the head changed the relation of the fluid level to the ear landmarks. Eustachian tube inflation caused a bubbling sound. Functional examination of the hearing revealed a slight conduction type of deafness. There was no otalgia at any time. Paracentesis was not necessary, and the patient was dismissed from observation three days later. In a letter, August 18, he says that symptoms of fullness and deafness are decreasing. The fluid level is lower.

Case 2 (A359235).—Mr. W. B., aged 48 years, had typical trifacial neuralgia. His ears were normal. Three alcohol injections were given on the right side May 28, December 15, and December 19, 1921, respectively. The last injection afforded relief, but the patient had a sense of fullness and deafness in the right ear. The ear ruptured spontaneously, and a thin watery fluid escaped. No further treatment was necessary. December 29, 1921, a gasserian ganglion operation was performed, the right sensory root being sectioned. Three days later, before the primary dressing was changed, the patient complained of slight pain in the right ear, soon followed by a spontaneous discharge of clear fluid.

Examination revealed a pale tympanic membrane slightly full in the lower quadrants with a posterior inferior perforation, and a thin fluid pulsating through the opening. This clear fluid became definitely purulent on the following day by secondary infection. Slow but steady improvement then occurred. January 14, 1922, when the patient was dismissed from observation, the tympanic membrane was retracted, the perforation healed, and subjective and objective symptoms had entirely disappeared.

Case 3 (A365379).—F. N. B., aged sixty-five years, had trifacial neuralgia. Preoperative examinations revealed normal ears. July 30, 1921, the left sensory root of the gasserian ganglion was sectioned. About nine days later the patient complained of fullness and slight deafness in the left ear.

The typical pale membrane with slight fullness in the lower quadrants and the slight deafness typical of the condition were present. There was no otalgia; paracentesis was not considered necessary. The patient was seen daily and the ear rapidly cleared. This patient also had a corneal ulcer in the left eye which was typical in its resistance to local treatment. Further trauma was eliminated by the use of a glass eye shield.

Case 4 (A358945).—Mr. T. E. G., aged sixty-eight years, had a right gasserian ganglion operation for trifacial neuralgia May 19, 1921. The sensory root was cut. The findings in the ears were negative. The patient was dismissed from observation without complications. However, a letter from his home physician revealed that he had subsequently developed right otitis media which spontaneously ruptured and became secondarily infected. He also developed a right corneal ulcer. Both resisted local treatment. A later letter, December 19, 1921, stated that both the ear and the eye were about cured.

Four other cases belong to this series, but since a personal examination was not made they are not incorporated in this report. The patient in Case 1 was typical in every detail and most interesting. It should be noted, however, that all the patients had complete relief from the pain after operation; they also had cutaneous anesthesia over the surface supplied by the posterior root of the ganglion. It should further be noted that two of the four patients had trophic disturbances

in the form of secretory otitis media and corneal ulcer; this again brings up the question of the factor of trauma in these cases of postoperative corneal ulcers.

SUMMARY.

1. Secretory otitis media following operations on the gasserian ganglion is an entity. It is probably due to trophic disturbances in the mucous membrane of the middle ear.

2. The nerve connections between the gasserian ganglion and the mucous membrane of the middle ear are abundant.

3. The ear and eye complications are always on the side on which the operation is performed.

4. Trauma, as an etiologic factor, is eliminated so far as the ear is concerned, and this gives further basis to the argument that the corneal complications are entirely trophic in origin.

5. The process may be similar to that occurring in a herpes zoster otiticus.

XXXVII.

NASAL REFLEX.*

BY ROBERT F. RIDPATH, M. D.,

PHILADELPHIA.

Nasal reflex or neurosis as a cause or in conjunction with other symptoms has been and still is in many instances a puzzling mystery; that located on or within the Schneiderian membrane there is a reflex to practically every part of the body has been demonstrated by many authors and writers, but to my knowledge has never been compiled into one paper or subjected to a dissertation under one heading.

It is therefore with this end in view I have made a compilation from the literature of the past several years, and have added thereto my personal experiences, in the hope that this subject may be made available for future reference.

INNERVATION OF THE NOSE.

The innervation of the nose is from the olfactory bulb sending filaments to the upper one-third of the nasal mucosa through the cribriform plate; from the sphenopalatine ganglion sending fibers to the superior, inferior and middle turbinates and to the septum, and from the external twig of the nasal nerve to the anterior part of the outer wall of the nasal chamber.

An important point to be borne in mind is that the mucous membrane is endowed with general sensation through the fifth nerve, by which vasomotor control is exerted in the vascular mechanism underling it.

The nerve connections from the nose to the genital sphere are especially numerous from the turbinated bone, as also those from the nose to the stomach from the middle turbinated bone, and from the nose to the heart from septum place.

F. Blumenthal¹ in critical studies of the nasal reflex neurosis says: "Irritation of the centripetal nerve fibers of the nasal

*Accepted candidate's thesis, American Laryngological, Rhinological and Otological Society, January, 1923.

mucous membrane causes functional disturbances in the centrifugal nerve region, and the sympathetic fibers are brought into play, which in the majority of cases may be considered as the nerve tract. These sympathetic fibers are numerous distributed in the nasal mucous membrane, and are secretory but here are vasomotor."

One can therefore imagine that the different reflex arcs which extend from a single organ are differently localized and that they do not run into each other but meet the nasal mucous membrane in certain places. Thus can the existence of the genital, gastric and cardiac places be explained.

B. F. Andrews² in 1915 states that "Intranasal stimuli may produce coughing and sneezing, which is doubtless brought about by impulse being switched onto the vagus, which receives sensation from the pharynx, larynx, bronchi and lungs, and motion to the muscles of the voice production, and some respiratory muscles in the larynx. It is fair to assume, then, that intranasal irritation is responsible for at least a percentage of cases of asthma associated with hay fever."

The nasal reflexes which are generally considered physiologic are sneezing, lacrimation, various secretions, turgescence, cough and hyperosmia.

Jurasz³ divides the disturbances of the normal reflex processes into three groups. In the first group are those in which the irritation affects the nose and also affects an additional reflex action beyond the nose, as asthma, spasm of the glottis, nightmare, nervous cardiac troubles, as cardiac pain, tachycardia, angina pectoris, epiphora, disturbances in the ears, migraine, headaches, epilepsy, exophthalmic goiter, St. Vitus dance, nocturnal enuresis, melancholia and hysteria. The second group includes the nasal reflex neurosis in which the sensory irritation exists in the nose and shows itself through a reflex in the nose such as hay fever, rose cold, railway and ipecacuanha cold. Finally among the third group are the reflex neurosis in which the sensitive irritation takes its origin in another organ and may transfer the reflex to the nose. There are again certain kinds of nervous colds, bleeding from the nose, sneezing, hyperemia and swelling of the nasal mucous membrane.

J. P. Lopez,⁴ in his paper "New Reflex Symptoms of the Nasal Origin," gives reflex mydriasis as caused by nasal obstruction, noting four cases in 20,000 patients, and states: "It has been found to coincide with the intense nasal obstructions, and the proof that these attacks of mydriasis are derived from nasal obstructions lies in the fact that mere touches of cocaine in the fossæ are sufficient temporarily to suppress the anisocoria, which disappears completely after an operation which corrects the nasal obstruction. The symptoms are rarely noticed by the patient, for in general it has no harmful sequela."

The writer concludes that in spasmodic mydriasis the reflex is transmitted through the intervention of the great sympathetic which governs pupillary dilatation; the reflex, starting from the nasal fossæ, whose nerves, forming ends in the sympathetic, would be excited by the inflammation of certain zones of the mucosa, causing the reflex in the ophthalmic ganglion to determine the mydriasis by means of the dilator nerves of the pupil which proceed from the ganglion.

The exact examination of Killian⁵ showed that in the region of the extension of the ethmoid nerve in the anterior section of the nose not all the mucous membrane regions were the place of the reflex actions in question. The point in which an increased sensitiveness in contrast to fine tactile irritation with great regularity could be proved was the tubercula septi and the section of the mucous membrane situated over the anterior ends of the inferior turbinated bones. In the normal, the author was successful in separating these places, through a great irritation, from epiphora and nose irritation.

ASTHMATIC REFLEX.

Asthma as a nasal reflex has been considered and recognized by numerous observers. Sluder⁶ says: "There is a great difference of opinion as to the way the impulse is transferred from the cervical sympathetic to the cardioaccelerator and pulmonary vasomotor fibers, but it seems that the relay station for the asthma reflex must be in the cervical sympathetic ganglions. If the asthma reflex may be controlled from the nose ganglion or the sphenoid sinus, then there should be places from which the reflex may be started experimentally or accidentally. Reflex asthma gives a decidedly different aspect

from the cardiac asthma or the asthma dyspepticum. In the typical asthma attack there are besides dyspnea in the expiratory phase, which produces flatulence of the lungs, the falling of the diaphragm, catarrh of the lungs and discharge containing Charcot-Leyden crystals and Curschmann's spirals, which make sure the diagnosis.

Kuttner⁷ characterizes asthma as a genuine reflex neurosis and concludes that "Here (in asthma) we have the type of a pathologic reflex in which the irritation of the reflex center is greater than norm, and the region of excitation is extended above the norm, and as the anatomic substratum in this pathologic reflex process is unknown at present, so we have to consider the reflex asthma as a genuine reflex neurosis."

The author wishes to report a case of asthma of true nasal reflex.

Mrs. J. P. K., age fifty-four, white, married, has had three children, all living and well. She had asthmatic attacks for fourteen years, occurring with equal violence night or day. She was referred to me by a diagnostician after years of treatment for intestinal toxemia, cardiac arrhythmia and unnumbered other diagnoses and treatment had utterly failed to have the least curative effect. Wassermann negative; blood pressure, 138-90. Well formed woman of middle age. Examination of nasal fossa showed a high deviation of the nasal septum pressing on middle turbinate right side, vomer ridge in left fossa forming synechia with posterior end of inferior turbinate. There were no polypi or other pathologic condition in the nose. During the preliminary examination (which was made without cocaine) the examining probe, when brought into contact with the synechia, caused a violent attack of asthma lasting thirty-five minutes, and was only relieved when the nasal mucosa was thoroughly cocaineized. A submucous resection of the nasal septum was performed, separating the synechia and relieving the pressure of the middle turbinate, with absolute alleviation of her asthmatic attacks for the past eight months.

CARDIAC REFLEX.

Rugani Luigi,⁸ in *Arch. Ital. di Otol.*, etc., 1920, states: "It is a well known fact that a not inconsiderable number of

individuals affected with cardiac rapidity are relieved from military service after fruitless efforts at cure and after passing the period of reexamination. It is therefore to the recognition of the fact that cardiac rapidity is consequent upon a nervous reflex of nasal origin and that even today little or no value is attached to the etiology of such disease of the cardiac apparatus."

E. T. von Bucke⁹ in his numerous experiments coincides with others and concludes that "The insufflation of irritating gases or fumes into the nose, with an expiratory stopping of breathing, produces an interference with the activity of the heart, which in the first place may be considered as a reflex irritation of the vagus through the sensory branch of the fifth cranial nerve to the nasal mucous membrane."

Knoll found that the retarding of the action of the heart with the irritation of the nasal mucous membrane in rabbits could not exclusively be traced back to an irritation of the cardioinhibitory fibers of the vagus.

Von Brucke reports seven cases (rabbits) in which the pulse frequency decreased during the chloroform experiment. In this respect H. Roger,¹⁰ in his admirable paper, suggests that the brisk projection of irritative vapors (ammonia, and especially chloroform and ether) into the nasal cavities stops respiration during expiration and raises the blood pressure, which is followed by systodiastolic oscillations. The cardiac manifestations are the same, even when the animal (rabbit) is submitted to artificial respiration. The brisk projection of irritant vapors through a tracheal tube produces respiratory spasms, with marked dilation of the thorax, which contracts very slowly. The cardiac manifestations are the same as in the irritation of the nasal mucous membrane. The cardiac manifestations are due to simultaneous action of two antagonistic powers, one lowering and the other raising the pressure. The first depends on the pneumogastric. After double vagotomy the neocardiac reflex is simplified, the depressive phase is omitted. The excitation of the nasal or bronchial mucous membrane brings at once a rise of pressure. In some cases irritation of the nasal mucosa causes a tetanic contraction of the heart.

Inhaling chloroform or ether does not produce the same effects as the brisk projection does; it lessens the respiratory movements and lowers the blood pressure, which seems to be due to toxic absorption.

DIFFICULTY IN DEGLUTITION.

F. Pontoppidan¹¹ reports two cases, the first in which deglutition was interfered with, and the second, that of persistent headache. I quote the first, which to me has more bearing as to a reflex cause than the second. "Female, forty-three years old, referred to the author for trouble in swallowing. She was unable to swallow potatoes, meat or rye bread. She lost weight. Pharynx showed slight yellow secretion from the nose. No headache but a feeling of pressure at the bridge of the nose. Diagnosis: Ethmoiditis duplex. Partial resection of the ethmoid cells. Removal of polypi. Patient recovered and can now swallow all food easily. Doubtless this was a case of reflex spasm of the constrictors pharyngei caused by the nasal condition."

NAUSEA.

Greenfield Sluder in 1921 observed and following numerous others have verified his observations that many cases of persistent and otherwise unaccounted attacks of nausea may be the direct result of a nasal reflex. Sluder's¹² observations were brought about when injecting the sphenopalatine (Meckel's) ganglion with 95 per cent alcohol. Nausea was produced and vomiting continued for six days intermittently. The same phenomenon also follows the postethmoidspenoid operation. After adding carbolic acid to the alcohol injection, nausea is much less frequent, but still sometimes follows.

Frequently pain from any cause produces nausea and vomiting. On many occasions a severe nasal ganglion neuralgia has been accompanied by nausea, which ceased with the cessation of pain by anesthetizing the ganglion. The author relates one case of severe nasal neuralgia which was accompanied by vomiting, even when pain was absent. The application of one drop of 10 per cent cocain to the nasal ganglion district stopped the vomiting. In another case of hyperplastic non-suppurative sphenoid headache, marked nausea without head-

ache is sometimes manifest. Applications of one drop of 10 per cent solution of cocain to the floor of the sphenoid cell stops it in ten minutes.

The author believes that these two anatomic subdivisions of cases should be thought of as one type, namely, that of sympathetic nervous system irritations, because of the intra-sphenoid cocainization of the vidian nerve in the vidian canal.

SEXUAL REFLEX.

Many authors, Fleisz, Killian, etc., have demonstrated beyond doubt the points of the nasal sexual reflex; confirmation has been the result in the hands of unnumbered rhinologists. These places are first the anterior position of the two lower turbinated bones, and second, the two sides of the nasal septum opposite. These show two elevations richly supplied with nerves and blood vessels, the so-called tubercula septi.

Fleisz, according to his reports through cocain experiments, could absolutely state to which group of the dysmenorrhea the single case belongs, for in the nasal form of the same he was always "dead certain" to remove the pain through cocain application in the genital places of the nose, and vice versa. After the effect of the cocain had ceased he could again kill the pain with applications of trichloracetic acid.

Skillern¹³ in his work, "The Accessory Sinuses of the Nose," states that "Inflammation of the sinuses often exercises a marked influence over the sexual function. In ordinary cases there is a marked deterioration, while in the severe cases it may be totally abolished."

One can readily see that the toxemia taking place during a sinusitis will lessen sexual inclination and function, and if the discharge continually pours and covers the points already proven it finally destroys the sexual nasal reflex. Of several cases I will report the following: Miss M. B., age 18, white, well developed and perfectly healthy except prior and during menstruation. Mother stated that two days before the flow she always complained of a fullness in the nose with a corresponding difficulty in breathing, also a terrific headache and cramps. These were of such severity that the patient was compelled to seek her bed, where she remained four days. During this time there was no alleviation of head or abdominal pains

except through medication. She had consulted two gynecologists and had two curretments without any relief. The last gynecologist, Dr. Brinkmann, sent her to me for nasal examination. Examination at this time revealed nothing abnormal. As this was midway between the menstruation, advised her coming a few days before the next periodicity.

On second examination, made three days before the expected flow, I found both inferior turbinates swollen to such an extent as to occlude the inferior nasal passage and press on the septum. On cocainizing, the mucous membrane of both turbinates contracted and looked perfectly normal. The patient was suffering from no other nasal or other condition that I could elicit.

Prescribing a 1 per cent cocain solution and advising the patient's mother to allow a few drops in each nostril several times a day and to report to me in two days, I was surprised, knowing the history of the case, to have the patient present herself for further examination and treatment on the day specified, stating that there had been no pain or other symptoms, although the menstruation had now been of twenty-four hours' duration.

Future treatment consisted in destroying the nasal sexual reflex areas by cautery, and the patient has had no return of her former discomfort for three years.

HAY FEVER

As the literature pertaining to hay fever neurosis is so voluminous and easily obtained, I shall not go into this subject. Sufficient to say papers and articles by Hallopeter, L. B. Baldwin, A. H. W. Caulfield, of Toronto, Nicholas and Lillian Kopeloff, A. B. Conklin, Frank Parker, of Stockbridge, George W. McKenzie and many others all clearly demonstrate the reflex neurosis in this disease.

HYPEROSMIA.

Increased sensitiveness to detect odors is found in the temperamental, hysterical, epileptic, hypochondria and may result from any invitation of the olfactory bulbs.

PAROSMIA.

Parosmia with subjective perception of imaginary odors, according to Sir St. Clair Thompson,¹⁴ is always a central nerve affection.

Patient reported by the author at the Philadelphia Laryngological Society in 1918: T. B., man 42, was referred to the Medicochirurgical Dispensary from the Neurological Department for complete examination of the upper air passages. Patient states that "he is always pursued by a horrible odor," this seeming to have its origin in his own body. While traveling on trolley cars, he invariably rides on the front or back platform so as not to disturb or be disagreeable to other passengers, and even in this position he is so conscious of the odor he frequently leaves the car to take another, perhaps several times before arriving at his destination. He also frequently changes boarding houses for fear the landlady will find out his peculiarity. Asked "if anyone ever spoke to him of it," he replied: "No, that seems to be the peculiar part; nobody knows I suffer from such a disagreeable disease except myself, and no one seems to be able to smell the odor but myself, but I am afraid they will." He would not visit his relatives or friends for the same reason.

Examination of nasal cavities revealed nothing abnormal, and after several visits to the dispensary vanished from our observation. Although apparently normal in other respects, we are forced to agree with F. St. John Bullen¹⁵ that parosmia is a perversion of the olfactory sense and frequently occurs in the hysterical and insane.

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XXXVIII.

TUMORS OF THE JAW FROM THE STANDPOINT OF THE RHINOLOGIST.

BY J. D. WHITHAM, M. D.,

NEW YORK.

Although new growths of the jaws are relatively uncommon, nevertheless their early recognition and early treatment are matters of importance. Malignant neoplasms of the jaws grow into the accessory sinuses and toward the base of the skull. Scudder states that "an intimate knowledge of these sinuses is necessary to the operating surgeon." The rhinologist has this knowledge and should possess the ability to diagnose and treat these conditions.

In the few minutes allotted, I shall attempt to briefly discuss the more frequent neoplasms of the jaw, giving the salient points in diagnosis and treatment.

An epulis is probably the most common tumor of the jaw. It is a connective tissue growth seated on the border of the alveolar process of the jaw about the teeth. It is seldom larger than an olive and is usually covered by intact mucous membrane. It nearly always occurs in young adults. Two varieties are described; the fibrous and the more common giant-celled type. The latter is softer, more vascular and more irregular in shape than the former. Metastases do not occur but the disease is locally malignant. The condition is treated by extracting a tooth on each side of the tumor, notching the bone in front and behind and removing the alveolar process with growth attached by a chisel. When this is done the condition never recurs.

Sarcoma of the jaw is extremely rare in childhood and when seen is usually of the giant-cell type. Most frequently it is found between the ages of 15 and 60. Trauma is believed to be an important etiologic factor. It is more frequent in the lower jaw and is apparently about equally as common in the jaws as carcinoma. A rare but very malignant form origi-

nates from a blood vessel. This is called a perithelioma. The two types of sarcoma most frequently seen are the central or medullary type originating from the bone marrow, and the peripheral or periosteal type, which, as its name implies, grows from the periosteum. The medullary type is surrounded at first by a definite shell of bone and periosteum. Often it is difficult to distinguish such a growth from a benign cystic tumor. The tumor growing rapidly destroys the bone, breaks through its capsule and invades the soft parts of the face or neck. The peripheral type, growing from the periosteum, does not cause extensive destruction of bone, and is not surrounded by a definite bony shell. It is softer than the bone to which it feels firmly attached and has definite outlines. In both jaws the body and alveolar processes are attacked with equal frequency.

The symptoms of sarcoma of the upper jaw are a swelling of the jaw with evidences of necrosis of bone; tenderness along the alveolar border; a tender spot on the cheek; loosening of teeth; ulceration extending to the hard palate; obstruction of one or both nasal cavities from a growth often resembling a nasal polyp; a continuous foul purulent nasal discharge with intermittent nasal hemorrhages; a tingling and numbness of the upper lip and cheek; a flattening and later a bulging of the hard palate; diplopia; edema of the eyelids and face; empyema of the maxillary sinus and evidences of a progressive necrosis of the jaw. The rhinologist is often called on early in these cases. With the aid of the X-ray and his experience he is especially qualified to make an early diagnosis. In reaching a diagnosis the following conditions must be excluded; alveolar periostitis, gumma, dental cyst, carcinoma and odontoma.

The treatment of sarcoma of the jaw usually entails an extensive primary operation, although in less malignant types a limited operation may be undertaken. The advantage of using the actual cautery in removing these growths is well established. The use of radium and X-ray in treatment will be briefly considered when carcinoma of the jaw is discussed. The results of all forms of treatment are so bad and the mortality so high that very early diagnosis seems to offer almost the only hope. By studying and thinking more about these

conditions and by co-operation with the oral surgeon, rhinologists can do much.

Benign tumors of the jaw are usually of the following types: fibroma, myxoma, osteoma, chondroma and mixed growths. The sinuses are frequently involved. Such tumors are slow growing but often produce most repulsive deformities of the face. The treatment is, of course, entirely surgical.

Another type of jaw tumor which is relatively common and which should be thoroughly understood is the odontoma. An odontoma arises from a portion of a tooth follicle or tooth germ as the follicle is sometimes called. To understand how this occurs, a rapid review of the development of a tooth is necessary. A tooth, like a hair, develops in early fetal life from an invagination of the epithelial layer into the mesoderm. In this way a flask shaped epithelial cord is formed which is called the enamel organ. The mesoderm of the rudimentary jaw grows upward and is called the papilla. This becomes completely surrounded by the enamel organ which is, in turn, surrounded by the sac of the tooth. The sac, the enamel organ and the dentin papilla together comprise the tooth follicle.

From the enamel organ of epithelial origin grows the enamel of the tooth. When certain of these epithelial cells of the enamel organ in the root of the tooth cease to form enamel, they may remain as epithelial cell rests. It is from these cell rests that the adamantine epithelioma or odontoma is believed to grow. This is a slow growing immovable tumor. It is more frequent in the lower jaw and is occasionally cystic. The patient is usually a young adult. This growth is locally malignant. One of its most interesting features is its microscopic resemblance to a carcinoma. The treatment is entirely surgical. If any doubt exists as to its malignancy, a resection should be performed. No case of recurrence after complete removal has ever been reported.

Cysts of the jaw are classed among the odontomata as they also grow from the tooth follicle. These are of importance to the rhinologist, especially when occurring in the upper jaw. They are of two kinds—the periosteal, or root cyst, and the follicular or dentigerous cyst.

The root cyst is the more frequent. It arises probably from the epithelial sheath of the enamel organ, beginning as a granuloma at the root of a tooth. A periodontitis ensues with degeneration and softening of the granulation tissue and cyst formation. The fluid is a clear yellow and contains cholesterolin and cast-off epithelial cells. In the upper jaw, growing in the line of least resistance, it may encroach upon the antrum or upon the mouth or nasal cavity. In the lower jaw it is seen on the lingual aspect, under the mucous membrane. The teeth are often displaced to one side. Fluctuation and the parchment-like crackling may be obtained. In the upper jaw, the floor of the nose and the floor of the antrum may be displaced upward. Exploratory puncture and the X-ray aid in diagnosis and are usually necessary when an infected root cyst has perforated into the antrum. The treatment is best carried on by the Partsch operation. This consists of a complete removal of the oral wall of the cyst and opens the cavity fully into the mouth. It always cures the condition.

The follicular or dentigerous cyst, though not so frequently encountered as the root cyst, is nevertheless a common form of benign odontoma. In the upper jaw it occurs as an olive-sized swelling on the outer side of alveolar process. It does not seem to encroach upon the lingual side. Its wall feels thin, and on palpation the parchment-like crackling may be felt. It appears usually during or shortly after the second dentition. It often develops from an unerupted canine or molar tooth, and the absence of this tooth may be noted. A dentigerous cyst arises from the follicle of an unerupted tooth, and at operation one or more tooth-like objects will be found in its cavity. It is usually monolocular and may grow to great size. The lower jaw in the molar region is the most frequent seat. Treatment is entirely surgical and consists of a complete removal of one wall of the cyst, thorough curettage of the interior of the cavity, and packing with iodoform gauze. This can usually be done through the mouth, and in this way little, if any, deformity will result.

The last type of jaw tumor to be considered is carcinoma. This will be spoken of briefly, for it is a subject quite familiar to us all. It is four times more frequent in men than in

women. In the jaws it is almost always primary. The central carcinoma of the upper jaw is nearly always primary in the maxillary sinus, and is usually of the cylindric cell type. More commonly, however, carcinoma begins in the oral or nasal mucous membranes. When the disease begins in the nose or sinuses, polypi or polypoid growths are usually present. A bloody discharge from one nostril, with nasal obstruction, should always excite suspicion. Neuralgic pain in the cheek is often an early symptom. Bulging of the antral wall, apparent in the cheek, orbit or nasal cavity is a later symptom. Enlargement of the cervical glands is a late manifestation, especially when the upper jaw is the seat of the disease. When the antrum is attacked a purulent sinusitis is nearly always associated. The X-ray is invaluable in the diagnosis of this condition.

After operation the average time for recurrence, according to Martens, is nine to ten months. It has been reported, however, as late as after eleven years. The results after operation are even worse than is the case with sarcoma. The use of radium and X-ray with early resection by the actual cautery seems to offer more hope. The treatment of an operable case of carcinoma of the jaw should be, in brief, as follows: About two weeks of preliminary intense treatment by radium should be given, using bare tubes and packs. During this period the teeth should either be extracted or carefully scaled and cleansed. The nose, throat and mouth should be cleaned every few hours with a mild spray and wash. The patient should be made accustomed to the stomach tube, that he may be less disturbed by its use after the operation. Very light ether anesthesia by the intratracheal method, with careful packing of the pharynx, will be found essential. A preliminary ligation of the external carotid artery on one or both sides is usually advisable. Everything should be in readiness to compress the common carotid artery if this step should later become necessary. The Rose position is believed by many operators to be the best. A suction apparatus is extremely helpful. The resection of large growths is best done by the cautery. Following operation, the patient should be fed by the stomach tube for about seven days, and external X-radiation should be given.

My object in reporting the following case is to show the possibility of removing one-half of the mandible without causing a very conspicuous deformity and to emphasize the usefulness of a preliminary ligation of the external carotid artery. In hemiresection of the mandible there is a great loss of blood when the ligation is omitted, despite the dexterity of the surgeon. The ligation serves to minimize the loss of blood, injury to the parts in manipulation and time of operation.

Patient, K. F., age 45, female. This woman has been an inmate of the King's Park State Hospital since 1902. She is feeble-minded.

Family, social and previous medical history have no important bearing on the case. In December, 1921, it was noticed that the patient was developing a swelling on the left side of the mandible. It was thought at first that this was a dento-alveolar abscess, and the molar teeth were removed. The tumor, however, continued to increase in size, and by February, 1922, had extensively involved the alveolar mucous membrane which was ulcerated. On February 19th, a section of the growth was removed. This was shown to three pathologists. One said the growth was a carcinoma, and two called it a spindle celled sarcoma. On May 14, 1922, a hemiresection of the mandible was performed under light chloroform anesthesia. The left external carotid artery was first ligated distal to the superior thyroid artery. This wound was carefully sutured and sealed with cotton and collodion to prevent contamination during the subsequent operative procedures. A vertical incision was then made on the lower jaw in the mid-line, commencing just below the carmine of the lip and extending downward to below the inferior border of the jaw, severing the soft parts, to the bone. The lower end of this incision was then extended backward below the jaw to the angle. The right coronary artery was clamped and ligated. The tumor was carefully separated from the surrounding soft parts. The levator menti, platysma and buccinator muscles were severed by the knife from their attachments to the bone, and while the anesthetist retracted the cheek the bone was cut from the oral mucous membrane. It was not possible to save the alveolar mucous membrane, as it was involved in the growth. The

massiter muscle and stylomandibular ligament were next divided with scissors and the mandible was cut through with a saw in the mid line. The cut end of the bone was then grasped with large bone forceps and forcibly depressed. This manipulation exposed the tendon of the temporal muscle at its attachment. Here it was cut with scissors, taking pains to hug the bone to avoid injury to Steno's duct. The external and internal pterygoids were next cut and the bone with tumor attached was readily removed by twisting and cutting the capsular ligament with blunt scissors. Up to this point the operation had been almost bloodless. Now a slight venous ooze from the pterygoid plexus was noticed, which was readily controlled by the gauze pack. All glands which could be found were removed. The oral mucous membrane was closed by a chain stitch of chromic catgut, the massiter and pterygoid muscles sutured together and a drain of one foot of iodoform gauze was inserted. The skin was closed, leaving an opening for drainage. The time of operation was one hour and forty-five minutes. The patient made a rapid afebrile recovery. She has had no return of the growth, has gained in weight and does not appear to suffer any inconvenience in eating as a result of the operation.

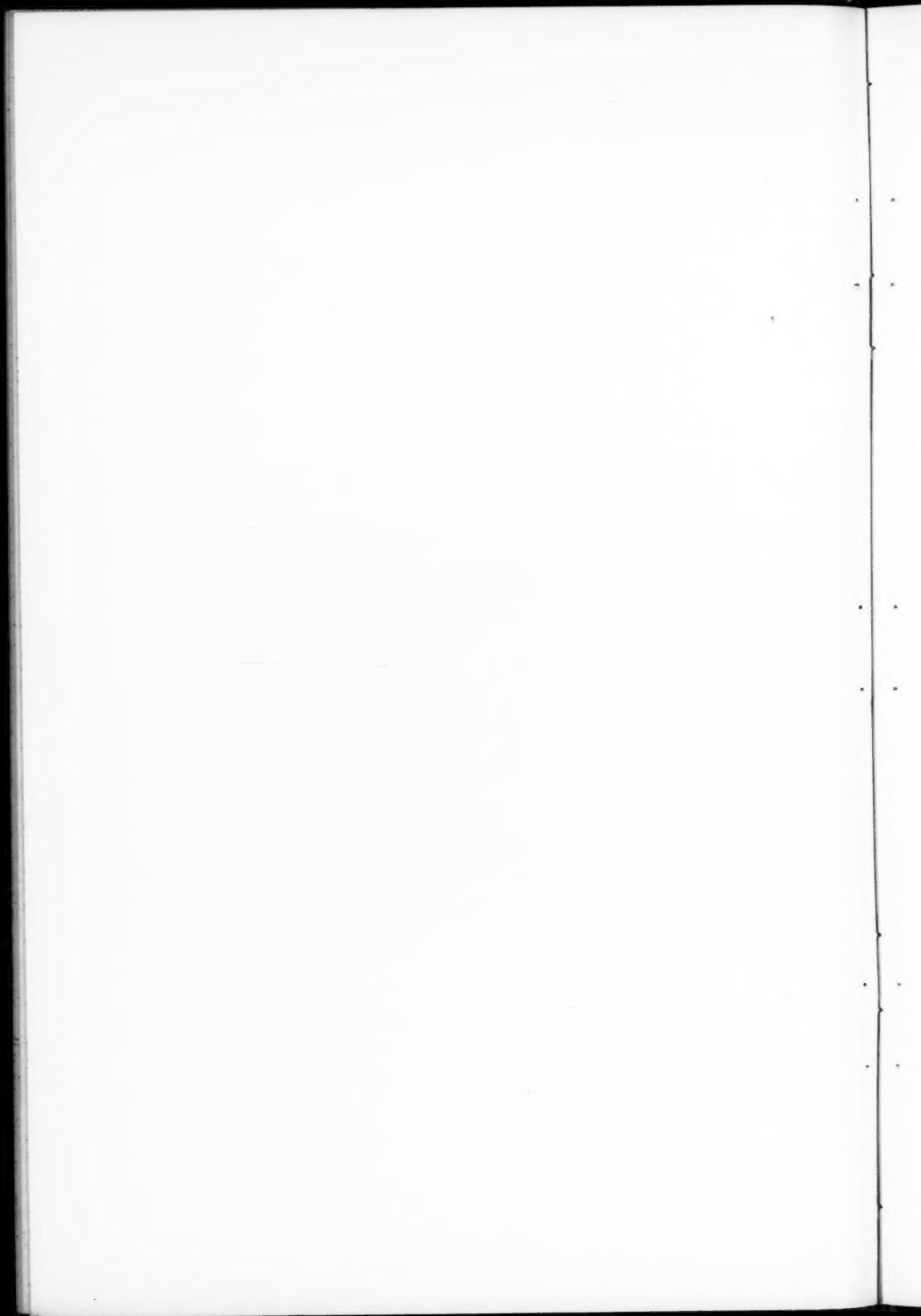
The growth and slide were shown to Dr. James Ewing, who called it an adamantine odontoma. The alveolar arrangement of the epithelial cells and the anastomosing stellate cells are characteristic.

The report of the pathologists before operation left the surgeon no choice. A complete operation was indicated.

34 EAST 61st STREET.

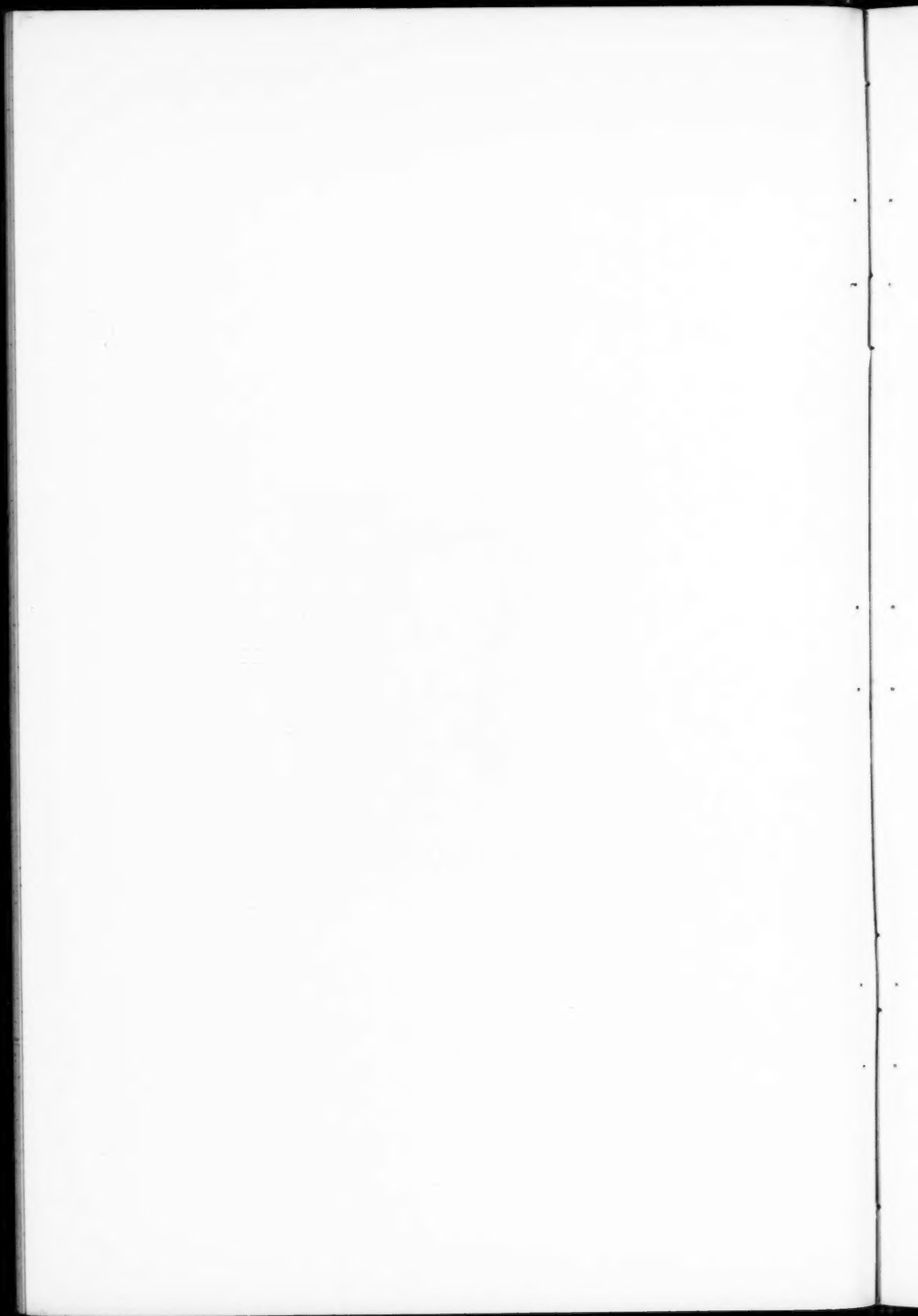


K. F. Adamantine Odontoma. Before Operation.





K. F. Adamantine Odontoma. After Operation.



XXXIX.

PHLEBOTHROMBOSIS OF THE INTRACRANIAL
SINUSES.

BY C. COULTER CHARLTON, M. D.,

ATLANTIC CITY, N. J.

As early as 1816 Abercrombie¹ drew attention to thrombosis of the lateral sinus, giving the symptoms and pathologic observations. Many articles have been written since then, but especially in the past twenty years most work has been done along this line. Knapp,² Van Dusch,³ Lapersonne,⁴ and Coupland⁵ were the first to give the profession valuable knowledge concerning thrombosis of the cavernous sinus, the signs of which are largely ophthalmic.

In 1845 Bouchut⁶ brought forward the results produced by marasmus in the coagulation of the blood in the veins, especially of the extremities, and stated that it may also be the cause of thrombosis of the intracranial sinuses.

The great width, the shape, the rigidity of the sinus walls and the angle, often against the current, at which the veins empty into the sinuses, all tend to favor coagulation in these localities.

Dental caries which caused a suppurative phlebitis, as well as gangrenous tonsils,⁷ have been reported as causes of sinus thrombosis; but the inflammatory or infected form, which mainly interests us, has as its most frequent cause suppuration of the middle ear and the destructive processes arising from it; yet any pathologic condition about the head or face as well as trauma may cause thrombosis. Anthrax, erysipelas, orbital cellulitis, retropharyngeal abscess as well as the above ear conditions have been reported as causing thrombosis of the intracranial sinuses.

In infective thrombosis there is always a phlebitic condition which, on account of the inflamed vessel wall, causes the blood to adhere and clot. This clot generally disintegrates rapidly as germ laden pus formed by the vessel wall mingles with it and forms greenish brown fluid which is filled with living

organisms and is likely to be carried into the circulation with widespread metastases.

The clot in sinus thrombosis begins by a fibrin deposit at point of invasion of the infection and may gradually enlarge to obstruct the vessel and extend from the lower end of jugular vein to all its tributaries, facial, thyroid, condylar, mastoid, emissary, superior and inferior petrosals, and through the lateral to the sinuses of opposite side. These thrombi may be mural or complete. When complete the extremities may be sterile through the action of the antiseptic circulating blood and yet the center, if infected, remains so. When the infected portion breaks through into the blood stream, septic emboli are carried to the lungs, joints and superficial tissues in the order named. Well presented, as the subject has been by Whiting and others, there is little need to go into the symptoms of sinus thrombosis, but it may be well to give a few which serve to differentiate the sinus involved.

The superior longitudinal sinus is most frequently affected with marasmus thrombosis, but being superficial and connecting with the parietal, the diploe and the emissary vein of Santorini makes thrombosis liable to occur from trauma and inflammation of scalp.

Edema of the scalp, overdistension of the veins over the parietal and the occipital regions, occasionally over the frontal when the anterior portion is involved, slight degree of squint are frequently observed and epitaxis on account of venous connection with nose, especially in infancy and childhood.

The Cavernous Sinus.—In the beginning of thrombosis of this sinus, the symptoms may be unilateral, but in over 50 per cent of cases it becomes bilateral. When the other side begins to show involvement, the one first observed may begin to show improvement of symptoms. The two groups of symptoms that are typical in cavernous sinus thrombosis are those due to obstruction of the venous circulation and to paralysis due to pressure on the nerves surrounding or passing through the cavernous venous plexis. The first group comprises exophthalmos, edema of the eyelids and the root of the nose, chemosis of the conjunctiva and retinal changes from engorgement of its veins; the second group strabismus, ptosis and

pupillary disturbances, which show involvement of the third, fourth and sixth nerves.

The Sigmoid Sinus.—Of all the sinuses the one that lies nearest to the cellular structure of the ear is the sigmoid portion of the lateral sinus. On the left it carries most of the blood from the interior of the brain, while on the right side it drains the surface blood from the veins. It varies in distance from the suprameatal spine, from close proximity to about one inch, and is the one most frequently involved. Körner states on an average the right sigmoid sinus is about 2.55 mm. nearer the postmeatal wall than the left.

Sigmoid invasion generally arises from a middle ear involvement. If in a chronic otitis media there is a sudden cessation of discharge with persistent pain extending into the head, high temperature with steeplelike fluctuation, vomiting and rigors, it may be regarded as pointing to thrombosis of the sigmoid sinus. Other symptoms that may be looked for are venous obstruction of the sinus, which causes overdistension of the external jugular and other superficial veins, and those caused by mastoid inflammation, tenderness and edema back in the posterior cervical triangle from the emissary vein as it emerges at the occipitotemporal suture. There may be enlarged cervical glands, especially along the internal jugular and soft tissue, cervical abscesses arising from venous thrombosis, systemic affection, pulmonary involvement, an infected enteritis and metastatic invasion of the joints or other tissues, even in the remote parts of the body.

The first record in otologic literature of operation on the lateral sinus is that performed by Samuel Ashhurst* of Philadelphia about 1875. Since then Zaufal, Horsley, Ballance, Lane, Grunert and Whiting have been the most influential of the pioneers in the field, while McKernon, Randall, Day and other American otologists have added a large contribution of cases to the list. In a careful study of the lists that have been reported and published, together with my limited experience, I think a great many of them were only phlebitis cases without thrombosis. A great number of these cases would no doubt have responded with less operative interference and many that died might have recovered if it had not been for the shock to the patients during the operation. This point

has been ably brought out by Randall.⁹ Quoting from his paper, he says: "The point which I have long insisted upon, that essential differences exist between the cases due to acute otitis as contrasted with the chronic, seems increasingly substantiated; but I believe that we must try better to recognize the nonthrombotic cases which may do better without operation."

Of course, we all know that a man of Randall's ability may do such, but for the average otologist, I am afraid, his patient would be submitted to a far greater risk than an exploration of the sinus, whether it be due to phlebitis or a phlebothrombosis. Many times the jugular has been ligated and sinus opened, even where no clot was found, and a fatal result avoided, as the bacteremia caused by phlebitis had been cut off from the general circulation.

Many nonfebrile cases have been reported by Alexander,¹⁰ Wild,¹¹ Uchermann,¹² Uffenorde¹³ and others where the sinus was obliterated. Ewing Day¹⁴ reported six cases of spontaneous cure accidentally discovered during operation. So it behooves us to go carefully and use every means to study our cases most thoroughly so as to give our patients the advantage of nature's own protective powers without lowering the resistance unnecessarily with operative procedures.

The consensus of opinion among otologists is in favor of ligation of internal jugular vein for lateral sinus thrombosis. I might state that, according to published records of many of the cases where the ligation was performed, no clot was found, but many recoveries took place because they were cases of phlebitis with bacteremia and by ligating infection was cut off from the blood stream.

Therefore, each case must be given a careful study, for, while we must realize that it is very important to operate early, it should not be at the sacrifice of our patient.

In the severe type of phlebothrombotic cases operated on about 80 per cent of the cases are successful, while in the milder type only about 70 per cent are successful.

The uncovering of the sinus presents little danger, but the statement made by some that the sinus wall would not be injured if the chisel or curette is used carefully is not altogether true, according to reports, as well as my own observation.

Grunert and Zeroni,¹⁵ Panse¹⁶ and Körner¹⁷ have reported grave sequelæ from exposure of sinus wall.

When the sinus has been exposed it should be packed with iodoform gauze plugs so that the pressure will be between the bony structure and soft tissue wall, completely compressing the vessel. After this the sinus should be opened between the plugs and the connected contents evacuated. After evacuation of the sinus thoroughly one plug is removed, and if spontaneous bleeding takes place it should be replugged, then the same thing should be done to the other end. If free bleeding does not take place search should be extended for the cause and curettement continued until bleeding is established. These plugs should not be removed before eight or ten days; if there is no bleeding replugging is unnecessary. A large portion of sinus wall should be removed.

In summarizing I wish to emphasize the following points:

1. All cases of suspected phlebothrombosis of the cranial sinuses, whether acute, chronic, traumatic or marasmic, should be carefully studied.

2. When we do operate, it should be done rapidly, thoroughly and with as little manipulation as possible.

3. Shock should be combatted by applying heat locally, hypodermoclysis and intravenous administration of saline and adrenalin when indicated.

4. We must strive better to recognize the nonthrombotic cases which might do better without operation.

5. Let us all try to develop our skill to such a degree that we will not submit our patients to any more than is absolutely necessary for a successful recovery.

CASE REPORTS.

Case 1. W. R. is a boy 12 years of age; the family history and that of the patient are negative, so far as the present case is concerned.

History of case: Two weeks previously he had been bathing in a pool one evening, and during the night complained of an earache. Next day he was all right and went to school. The family physician was called later to see the boy with a history of having chills and fever for three days. His report shows

that he found boy lying on his back with legs flexed; his eyes were closed and oversensitive to light, the pupils equal but slow in reaction to light (there was no nystagmus) and he did not complain of headache. The breathing was rapid; the temperature was 103 F.; there was slight stiffness of the muscles of the neck and the reflexes were exaggerated. The patient was very irritable when moved or otherwise disturbed, but quiet when left alone.

The following day I was called in consultation and found the above mentioned symptoms present, just as stated by the family physician, except that temperature was now higher, being 104 F., the pulse 124 and the respirations 24. On examination I found the nose and throat apparently normal, as were also the tympanic membranes; there was no tenderness or swelling over the mastoid regions or over the remaining portions of skull.

A blood examination was made, showing: Hemoglobin, 80 per cent; red blood count, 4,000,000; white blood count, 20,000; differential count, normal; urinalysis, negative.

A spinal puncture was made and the fluid, which flowed under a slightly increased pressure, was clear. Microscopic examination showed about six leucocytes to the field, and cultures taken, after seventy-two hours, were negative.

The patient was seen by me on three consecutive days before I could convince myself that the case was anything more than one of meningitis. On the third day I was able to detect a small localized area of tenderness over the right mastoid posteriorly, but other physicians who were present were inclined to doubt this.

As the patient was getting worse and the case seemed hopeless unless something was done, I advised operation. The patient was sent to the hospital and the mastoid opened. The outer plate was hard, but the cells and the inner plate soft, and after curetting, the sinus was exposed and pus found surrounding it. The sinus wall looked healthy, was compressible, pulsating and soft, no indication for opening. The patient was returned to bed with a fair prognosis.

By the fourth day after operation the patient's temperature was normal and remained so for about seven days, when it suddenly rose to 104 F. The day before this rise the patient

had complained of tenderness and swelling in the left elbow, which on the following day had to be put in a splint on account of the extreme pain on the slightest movement of the joint. A culture was made of the blood, but it proved negative. X-ray plates also failed to show anything. Cultures from the wound proved the presence of a mixed infection, showing staphylococcus pyogenes albus and a few short chains of streptococci.

A few days after the involvement of the elbow the patient's left ankle became red, swollen and painful. The swelling was so great that aspiration was decided upon and a ropy fluid was obtained, but no growths appeared on cultures made from this material. X-ray plates of this joint were negative. At this time the temperature jumped up to 105 F. and I decided to open the exposed sinus, which bled very freely, but a small thrombus was obtained. In this case the jugular was not ligated. Within three days the temperature was down to 100 F. and he gradually improved. It was necessary to keep the ankle and elbow in splints. After the temperature had remained normal one week the ankle was put in a plaster cast and the patient was able to get around on crutches. It was six weeks before the elbow cleared up; the ankle took longer, two months elapsing before the patient could give up the use of his crutches, and three months before the ankle was normal.

Case 2: E. R., a boy of 9, was first seen at my office on January 8, 1920. His mother brought him in for an examination, as he had been sick frequently with upset stomach and as she thought not as strong and healthy as he should be. He gave a history of having his tonsils and adenoids removed four months previously. About one month before he came to me he had a sore throat, slight fever and complained of both ears. At that time, his mother stated, he had white spots on each side of his throat. He was sick only a few days and everything apparently cleared up. Two weeks later the doctor who treated him for the above attack was called again. At this time, his mother said, he had the same kind of spots on his throat, but also had a slight rash on his body. The health physician of our city was called in consultation, as they thought it might be scarlet fever, and it would be necessary to quarantine him. After consultation it was decided he did

not have scarlatina and he was treated for a sore throat. After a few days he seemed to be entirely all right.

Examination.—The boy was apparently well formed and well nourished. His throat showed pieces of tonsils that had not been entirely removed, containing small crypts filled with cheesy debris, but about a normal color. The ears at the time were apparently normal except for a slight dull thick look to the membrane tympani, about what would be expected from a child that gave a history of frequent attacks of tonsillitis and sore throat. Not being able to find much wrong with him in my line of special work, I referred him to a pediatrician of our city, who reported to me as follows:

Pediatrician's Report.—E. R. History of convulsive attacks after any illness accompanying fever. Fairly well. Sore throat and fever five days at time when supposed to have scarlet fever. Slight efflorescence not followed by desquamation, abscess over body frequently lately, headache, no running of ear. Appetite fair, bowels good, restless at night. All organs normal, no enlarged bronchial glands. Reflexes normal. The attacks are like epilepsy, but always with fever. Gave instructions as to diet. Ten days later records show patient recovering from tonsillitis. Earache; gets pale and face twitches, probably convulsive attacks, as he always has fever. Physician ordered sodium bromid, five grains, t. i. d.

The pediatrician asked me to see the boy again and I found him suffering from an acute follicular tonsillitis. At this time his ears did not give him any trouble, but I looked at them each time I saw him, but did not observe anything wrong. In a few days his throat had cleared up and I did not see him again until about the 23rd of January. At this time he had complained during the night of a fullness and slight pain in left ear. I examined him carefully; his temperature was 101 F., pulse 80, respiration 20, throat and nose slightly congested, ears apparently normal, hearing good. For the next three days I saw him daily and he remained about the same except an increase in temperature to 102 F. At this time the boy looked ill, and on account of the history of some pain in left ear I did a paracentesis. Why I did this I do not know, as I was not able to observe enough to warrant it; perhaps remembering the custom at a children's hospital where I formerly

did some work of puncturing the drum if a child had a fever and if it could not be accounted for. In this case only the one was opened in which he had previously complained of pain. The paracentesis was performed at 6 P. M. January 25th, and only about one drop of blood was noticed. Later in the evening I made arrangements with one of our general physicians to see the case the next day. Early the next morning I called to see patient and found him with every symptom of acute mastoiditis and a profuse discharge. He was sent to hospital; laboratory examination made of blood showed: Hemoglobin, 88 per cent; red blood count, 5,000,000; white blood count, 12,800, polynuclears, 78 per cent; lymphocytes, 26 per cent; large mononuclears, 5 per cent. Temperature at this time was 103 F., pulse 104, respiration 28. One hour later his temperature jumped to 104 F. and an operation was decided as soon as patient could be prepared. A simple mastoid operation was performed.

Operation Findings.—Thick outer wall of mastoid, cells partly broken down; pus; necrosis; soft bone and pus; sinus exposed about one and one-half inches; was pulsating and compressible; wound left open and dressed. Patient sent to his room. Next morning temperature was 100 $\frac{3}{5}$ F. and remained there for three days. Suddenly on fourth day after operation temperature rose to 104 F. Patient developed a rash on right arm and chest, was restless, meningeal cry, semi-conscious, Kernig's sign present, stiffness of neck and tenderness of joints with pain on slightest motion or pressure.

The visiting ophthalmologist at the hospital examined his eyes and reported partially choked disc and that in a few hours he would no doubt be blind.

Lumbar puncture was made at this time. Fluid clear, but came out under great pressure. Culture made and laboratory reported a few chains of streptococci.

After spinal puncture eyes examined next morning and doctor was surprised at the way the eyes had cleared up.

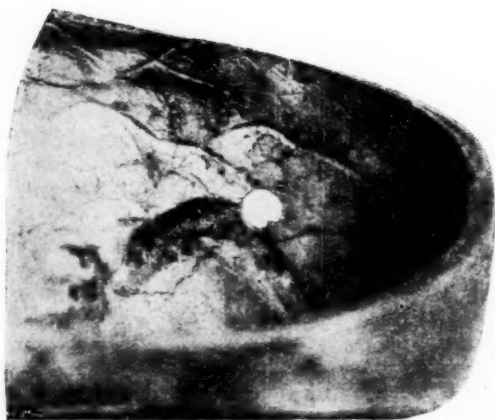
Patient was sent to the operating room, as he had another decided chill and we realized something had to be done rapidly to save the boy. Granulations were cleaned out, sinus exposed and opened, no blood from proximal end. The jugular vein was ligated and a portion resected, sinus then curetted

and a large thrombus was found down in the bulb. Distal end being packed off with iodoform gauze, a cigarette drain was inserted into the bulb and dressing applied. After three days the temperature was down to 100° F., and gradually improved till patient was transferred to his home, seventeen days after operation.

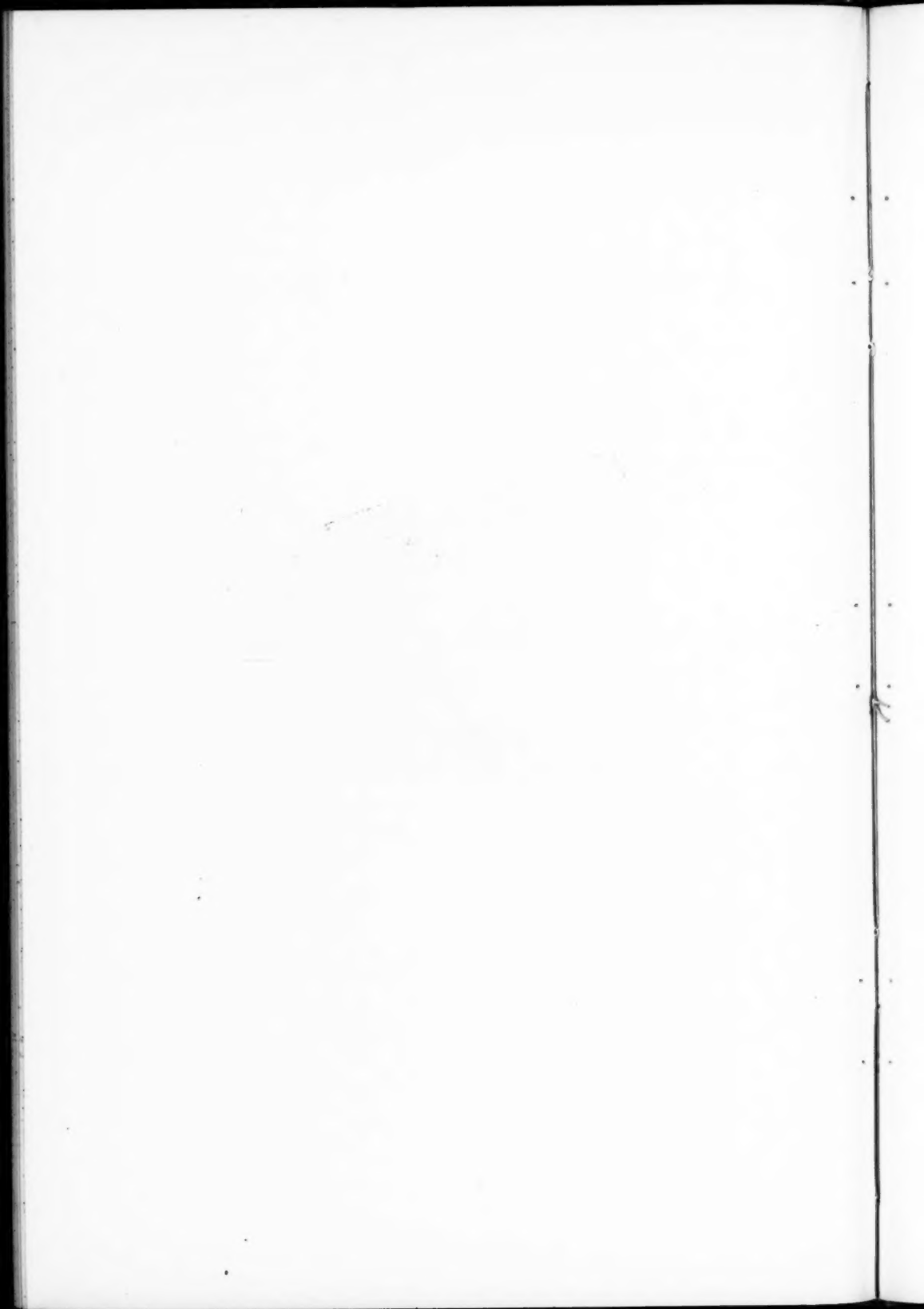
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124 SOUTH ILLINOIS AVENUE.



A skull trephined for mastoid caries and lateral sinus thrombosis
by the late Dr. Samuel Ashhurst of Philadelphia,
some forty years ago. (8)



XL.

DENTAL RELATIONS OF THE EYE, EAR, NOSE
AND THROAT.

By W. H. HASKIN, M. D.,

NEW YORK.

These relations are far more numerous than are generally recognized, and should be considered under several heads. There is scarcely time to give more than a brief outline of some of the most important.

The most prominently before us at the present time are those conditions arising from focal infections, but as a matter of fact they should be the last to be considered if we learn to study diseases from the standpoint of cause and effect.

The writer feels that this subject is of far greater importance than that simply dealing with focal infections, and that for it to be fully appreciated one must go back even to the early embryonic stage of development. Many of the serious problems start at this time, and can be recognized in the fetal skulls at birth, as will be shown on the screen from slides loaned by Dr. B. W. Weinberger, of New York, who has studied and written extensively of his findings.

The following outline is suggested to anyone who cares to take up a real study of the subject, and it is a most fascinating one, growing more interesting the deeper one goes into it.

1. Maxillary development.—(a) Embryology of bones; (b) embryology of teeth and alveoli; (c) postnatal growth; (d) faulty developments and causes.

2. Faulty maxillary development.—(a) High and narrow arches; (b) short anteriorposterior arches; (c) narrow pyri-form orifices; (d) dental irregularities, over and underbite; (e) delayed dentitions and impactions; (f) effects of premature extractions; (g) probable effect on the orbital cavity causing heterophorias; (h) atresia of the posterior choanae.

3. Causes of faulty development.—(a) Systemic diseases of parents; (b) improper balance of foods, vitamin; (c) insufficient endocrine secretion; (d) insufficient amniotic fluid in

utero; (e) artificial bottle feeding; (f) insufficient mastication, i. e., lack of proper stimulation of tissues to induce growth, both of teeth and bone; (g) premature extractions.

4. Nerve reflexes due to faulty developments.—(a) Headaches not localized; (b) pains referred to ears, eyes, etc.; (c) neurasthenias and insanity; (d) dysphagia and dysphonia; (e) tinnitus aurium; (f) eyestrain; (g) general irritability.

5. Focal infections.—(a) Apical abscesses, acute and chronic, toxemias, bacterial infections; (b) pyorrhea.

6. Causes of pyorrhea.—Uncleanliness, poor mouth hygiene; accumulation of food particles, improper brushing, poor contact points. Malocclusions, faulty occlusal surfaces; supra and infraocclusions, uneven surfaces of tooth at cervical margins. Traumas, rough edges of fillings; marginal injuries, rough edges of crown bands; rough edges of cavities; ceruminal calculus; improper use of toothpicks. Systemic disturbances: Syphilis, diabetes, tuberculosis, anemias, scurvy and rickets, intestinal toxemias, metallic poisonings, improper diet.

7. Maxillary tumors.—Sarcomas, malignant sarcomas, non-malignant fibromas, myxomas and fibromyxomas, dentigerous cysts, cysts from apical abscesses, osteomas, odontomas, supernumerary teeth, polypi.

Time will only allow me merely to touch upon some of the conditions that occur during the different periods as classified. Failure of union between the frontonasal process and the maxillæ, either on one or both sides, results about the tenth week of fetal life. The dental laminae appear on the alveolar processes of the maxillæ as early as the seventh week and calcification during the sixteenth week. The crowns of all the deciduous teeth, the four permanent incisors and the four first molars have already reached their final size at the time of birth and distinct evidence of faulty structure is found in them even before they erupt, these faults leading to early decays and premature loss. It has been well established that malocclusions are often found at birth, due, it is claimed, to deficient amniotic fluid while in utero and in some cases to the traumatism at delivery. These malocclusions are so marked in some cases as to interfere with proper nursing and the bottle has been resorted to for that reason and not from any lack of milk supply on the mother's part. It is in-

teresting to note that enlarged adenoids are present in these cases.

In the second classification the nose and throat are directly affected very seriously and all because of the teeth and indirectly the ears are very likely to suffer secondarily. Failure of the teeth to spread the upper jaws causes the high palatal arch generally associated with angular deviations of the septum, especially when there is a delayed eruption of the upper permanent incisors, as shown by Dr. Mosher, and these narrowed jaws will generally show a great narrowing of the pyriform orifices. It is at this point nasal obstruction will be most commonly found, and this also constitutes the reason for so many failures to relieve obstructed breathing in even the most satisfactory submucous operations. Every nose should be carefully examined for this point of obstruction before operation, and if it is present it can be safely said that there is a malocclusion. If it is present you may be sure that there is a malocclusion with a narrow palatal arch, the upper teeth occluding within the lower, so that every effort of mastication only tends to increase the narrowing of the upper arch instead of tending to spread it if they were in proper occlusion. On the other hand, the arch may be plenty wide enough but there has not been enough downward and forward growth due to slow development from inadequate stimulation of mastication (this being probably the greatest factor in producing such appalling early decays in the teeth of our children). In these cases you will find a marked vertical bow in the septum, which is probably explained by recognizing that the vomer belongs to the cranial bones and grows to correspond in size with them, only to find that the maxillæ have not grown sufficiently and that there consequently is not room for the vomer and it bends as a result. Also this failure of forward growth interferes with the caudal rotation (Dr. Schaeffer) of the posterior end of the alveolar arch and causes impactions of the molars, and undoubtedly reacts upon the nerves which descend on the posterior wall of the antra. It thus affects the innervation of the eyes, which with the shortening of the orbital cavity in all probability can account for many of the heterophorias which are commonly found at this period of the child's development, as observed by Dr. Daly of Boston several years ago.

In the writer's experience, delayed dentition has been found the cause of many serious ills, both painful and otherwise, and it has become a routine practice for him to examine all patients for these easily determined conditions, and to be guided by what is found. There are two periods where delayed growth can readily be determined: First, whenever it is found that the distance between the inner cusps of the child's second molars does not measure 33 mm. there has been insufficient growth, and if this distance is less than 29 mm. at three years, Dr. Bogue claimed that there never would be sufficient growth without artificial aid. This can be supplied by systematic daily exercise of the muscles of mastication, as suggested by Dr. Rogers of Boston, but it takes a great deal of patience on the part of whoever is in charge of the child. Second, if the deciduous incisors fail to separate before the fifth year there will be delayed dentition of the permanent teeth, not only of the incisors, but also of all the teeth, for the upper ten permanent teeth occupy the space left when the deciduous teeth are thrown off, and the separation of the deciduous teeth must take place if the arch is to become large enough for the permanent teeth to erupt in a natural manner. As mentioned before, Dr. Mosher claims that delayed eruption of the upper incisors is a frequent cause of septal deflections, the premaxillary wings being displaced to one side or the other. There are many other important things to be considered in thinking of these cases, but time will not allow me to describe them at this reading, but I want to add this important fact, and that is that in all cases of delayed dentition the roots of the teeth are bound to be distorted in the same direction, and this adds to the difficulties encountered later in their treatment. It is also a fact that these cases are always associated with some form of malnutrition and with poorly developed chests and lungs. A great deal has been written on the influence of the endocrine secretions as a contributing cause of delayed dentition, and it is claimed that the lack of these secretions in the milk of bottle fed babies causes faulty growth of the teeth from lack of proper calcium deposit, thus accounting for the rapid decays in early life.

Another group of investigators have clearly shown how a lack of the proper balance of the vitamins will produce decal-

cification of both bone and tooth structure in animals and that by giving the proper balance the calcium content will quickly return to normal.

One could write a long paper on the last two phases alone, and much that is of great interest and value has already been written on the subject by Howe, McCollum, Griener and others.

Personally, the writer believes that the greatest of all causes in producing malocclusions with the resulting asymmetrical developments of the face, causing nasal obstructions and orbital troubles, is the lack of full muscular efforts in feeding. This begins in infancy and continues on practically throughout life, especially in this country. One can readily appreciate the muscular action that goes on in a sucking child's mouth by inserting a finger in his mouth. Dr. M. Hellman has pointed out the great loss that occurs in the bottle fed babies, when he states that the average time consumed by an infant in emptying an eight ounce bottle provided with the best nipple and having the smallest aperture is about eight minutes, which with eight feedings a day would give only sixty-four minutes of actual work in the twenty-four hours, whereas the time consumed at a breast feeding averages about twenty minutes, or one hundred and sixty minutes, a difference of nearly one hundred minutes.

When one stops to consider that the growth of bone depends largely upon the stimulation supplied by muscular action, he is forced to appreciate what such a great difference must mean in the facial development.

Dr. Hellman further states that of eighty-four cases of malocclusion personally studied, 81 per cent occurred in bottle fed children.

Dr. Herdlicka, in a paper from which the writer quoted in a paper written in 1915, states that after an observation of 960 children of Apache and Pima Indians, lasting over two years, there was no abnormal narrowing of the maxillary arch nor protrusion of the incisors, and no irregularities, except an occasional crowding of the incisors, and that the arches were broader in the second temporary molar region than in the case of white children with the same type of skull and that the bones were generally heavier. That he never found a case of adenoids or of tonsillitis in an Indian child nor one who

was a mouth breather, this in spite of the fact that they lived in the worst possible hygienic atmosphere of dirt and poor ventilation. He also made this most significant statement: The Indians have had and still have the habit of keeping up the nursing of the child until the second or third year, and even later. And this important fact was noted, that the mother gave her child various things to chew upon very early in life while she still continued nursing late.

Here we have the double value of muscular action and a natural sterile and easily digested food, supplemented at an early period by food that required mastication, and thus produced stimulation of the dental germs, thus aiding in producing strong, healthy teeth with firm alveolar processes to hold them in place.

Another most significant fact is that the immigrants of all countries entering this country, with the exception of the English, Irish and Norwegians, have remarkably well developed jaws and teeth, attributed to the foods that they have eaten and their habit of nursing their young.

The exceptions use the refined flour breads, large quantities of potatoes and well cooked cereals, none of which requires much mastication.

Again, the children of these same immigrants very quickly begin to show the same dental disturbances that are found in our children, probably due to the change in food and consequent loss of muscle stimulation.

What all this has to do with the dental relations of the ear, nose and throat will be readily realized when its scope is understood.

Every pronounced case of malocclusion is a mouth breather and is thus more susceptible to colds and sore throats, with the possibility of infections of the ears. Mouth breathers lose the great moulding power of the tongue in spreading the arches both outwards and forwards, dragging the arch downwards, and the facial muscles are constantly at work pulling the bony structures in abnormal positions. The teeth being poorly developed, rapidly decay and are prematurely lost, adding another factor in delaying eruption of the second teeth, and throwing the whole balance of articulation out of gear when the sixth year molars are lost, for they are the real

anchors of development of the jaws during the crucial period when the deciduous teeth are being thrown off and the permanent cuspids and bicuspid are erupting. When it is known that among the high school children of New York, averaging about 14 years, less than one-half of 1 per cent were found to have four permanent first molars and that in many extensive decays were found in one or more of the teeth, it will be understood how important it is for all medical men to make it their duty to watch the teeth of all their small patients and insist upon their care.

As stated at the beginning of this paper, focal infections hold the place of greatest interest in the minds of most of us. I now want you all to think the above rambling remarks over carefully, for if we could only make the parents take that interest in their children and learn how much depends upon the proper foods and mastication of these foods, we would go a long way towards preventing malocclusions and early decays. In this way there would be a great difference in the development of the abscesses which are so universally found, and in the dreaded cases of pyorrhea, which are ever on the increase, due to the poor nutrition, the irregularities, the fillings, crowns and other forms of dental restorations. There is hardly a journal published in these days that does not contain an article on focal infections or refer to them in some way, and I shall not attempt to tell of my own years of experience, but will close with a heartfelt plea for you all to study it all out for yourselves to realize how important it is to get down to actual causes if you are fully to appreciate what the effects are to be and how you can best combat them. The damage has already been done beyond repair in most of our mouths, but we ought to be able to stop a great deal of similar troubles in our children if the effort is made intelligently, and if the generations following us could only carry on the work it would not be too much to hope for to have a stronger and better developed race of people besides the saving of the suffering that comes from diseased teeth.

XLI.

THE CORRECTION OF EXTERNAL DEFORMITIES
OF THE NOSE.

BY SIDNEY ISRAEL, M. D.,

HOUSTON, TEXAS.

Reviewing the necessity for, and the accomplishments of, plastic surgery during the recent war, directed at various parts of the human anatomy, and recreating, so to speak, many unfortunate persons, one can well appreciate the reason why rhinoplastic surgery has attained its present interest in the field of corrective or cosmetic measures, in an effort to transform one of the most noticeable features of the face, when unsightly, into something more useful and agreeable to look on.

It is of sufficient import to mention, in passing, the mental unrest in the minds of certain of these patients, resulting from the extreme self-consciousness of an unsightly feature of the face.

Historically, this character of surgery originated many years before, but its application and refinement of technic, together with numerous original ideas, have developed during our time, as a result of the investigation of such enthusiastic workers as Joseph of Berlin, Major Gillies of England and our own Roe, Carter and Cohen, and others.

Etiologically, external deformities of the nose should be classified into two main groups: (1) Congenital, and (2) acquired; the second group, including those due (a) to trauma, or (b) to disease (syphilis, lupus, etc.).

Anatomically, or from the parts involved, these deformities may consist of: (1) Bone, (2) cartilage, or (3) bone and cartilage.

In directing our attention to the correction of these deformities, several essential principles are to be kept in mind, if our results are to be all that we would have them:

1. There must be no external or visible scar, if it can possibly be avoided (the so-called intranasal approach).

2. We must have a clear understanding of the deformity and the necessary measures for correction, suitable to the individual face. This can be gained only after careful study and planning prior to operation.

3. Our technic must be as mechanically and aseptically above criticism as possible.

4. Whatever surgical step is taken must be corrective and accurate.

With these essentials, we turn our attention to the various types of external deformities of the nose, usually encountered in civil practice: Hump (dorsal); lateral bend; drooping or elongated tip, with or without dorsal hump, the so-called hook nose; pug or upturned tip; wide nostril with flat tip (African type); and saddle deformity, or a combination of one or more of these.

We find, in many cases of external deformity, an associated deviation of the nasal septum, requiring correction. I agree with other observers that only a conservative form of septal resection should be performed, to avoid failure or mishap.

Local anesthesia is the one of choice wherever it can be employed, and its use offers many advantages that are only too obvious. This form of anesthesia has been made use of even in the correction of saddle deformities of the nose, wherein a piece of the costal cartilage was taken for transplantation. When the technic of local anesthesia is properly carried out, there should be no pain. The patient is placed in the sitting position during operation, or semirecumbent at an angle of 45 degrees.

The technic of operation is as follows: After the preliminary cleansing of the face, the skin over the dorsum and sides of the nose is painted with a 5 per cent solution of tincture of iodine. The nostrils are cleansed with warm physiologic sodium chlorid solution, and the anterior nares swabbed with a 5 per cent solution of tincture of iodine. The line of incision is made within the vestibule in the outer nasal wall, through the cartilage, until the skin covering the nose is reached. Through this incision, repeated on the opposite side if necessary, the skin and periosteum over the entire nose is elevated from the nasofrontal articulation to the tip, and as far over the nose laterally as required.

With this subcutaneous elevation of the skin accomplished, through the incision, whatever surgical procedure necessary to properly correct the existing deformity, whether it be the removal of a hump, straightening a lateral bend, elevating the tip for the correction of hump nose, or the reception of a cartilage transplant, can be readily carried out, with no injury to the overlying skin and the avoidance of external scar.

In order to avoid an external scar, the incision should be made within the nose, the so-called intranasal approach. I cannot see why any of these patients, possessing no defect of vision, should be required to wear spectacles with plano lenses, merely to hide an external scar over the bridge of the nose that could have been avoided by the intranasal approach.

In the use of transplants for the correction of saddle deformities of the nose, cartilage has in our experience given the most uniformly good results.

I am not yet convinced of the wisdom or need of sacrificing a normally functioning turbinate and running the risk of producing annoying intranasal discomfort as a result, for the purpose of rebuilding an external depression of the bridge. I feel that this opinion is strongly supported by the fact that cartilage is so readily accessible and can be molded and handled with so much greater ease, in addition to its superiority in withstanding infection and not eventually being absorbed.

The reaction locally, following the correction of these external deformities, is negligible and promptly subsides. Curiously enough, the patients suffer practically no pain following operation and little or no discomfort. They are required to wear for a short time a properly molded splint, which must be suited to the individual case; therefore, the postoperative management is important. We feel that the rhinologist is the one best suited for this field of surgery, owing to his special knowledge of the parts involved.

Each case is a separate and distinct mechanical and artistic problem itself, and one should possess the necessary mechanical skill and appreciation of the proper anatomic ideal to be approached.

403 CARTER BUILDING.

CASE 1. DORSAL HUMP DEFORMITY.



Before Correction.



After Correction.

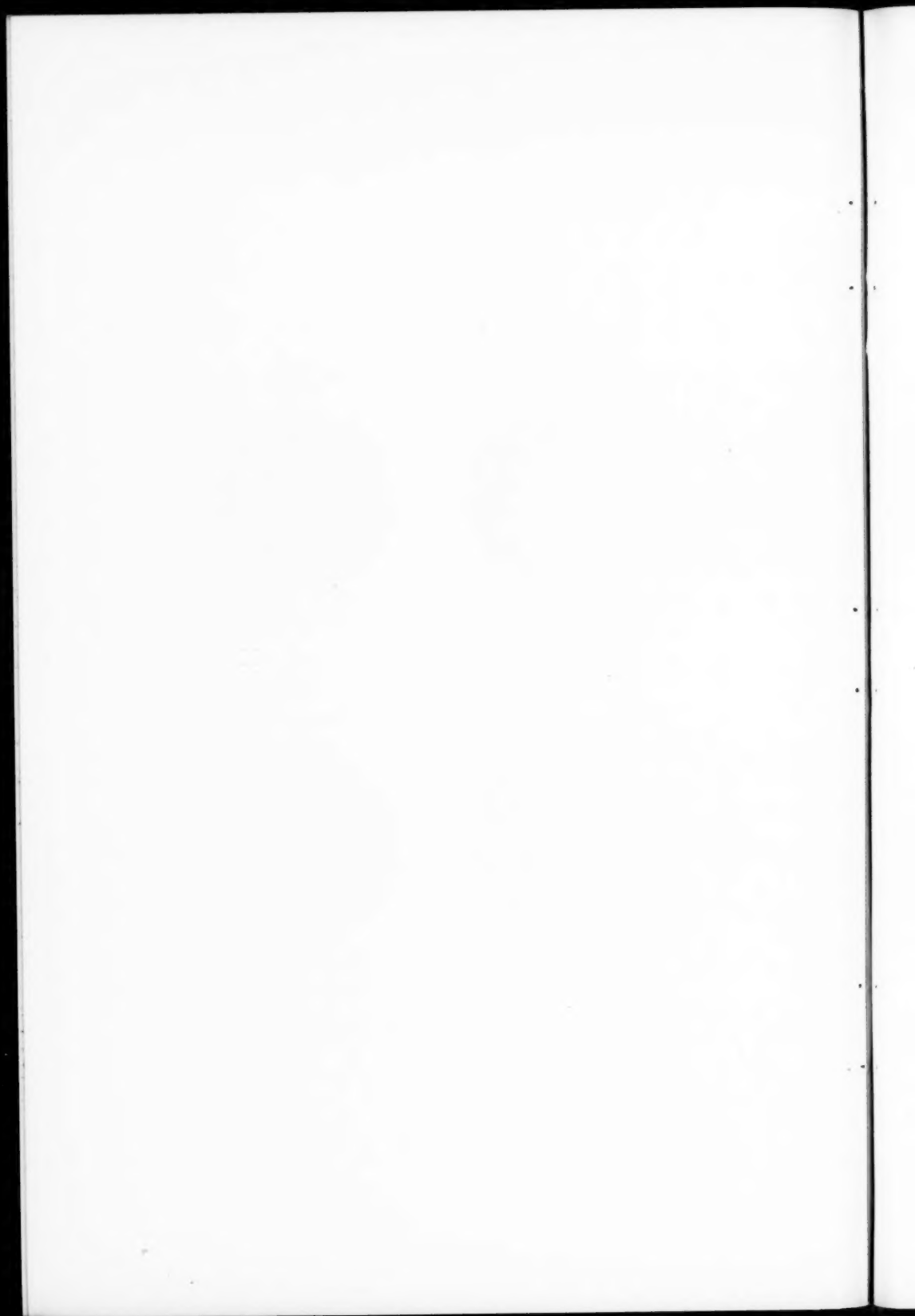
CASE 2. LATERAL DEFORMITY OF NOSE.



Before Correction.



After Correction.



CASE 3. LATERAL DEFORMITY OF NOSE.



Before Correction.



After Correction.

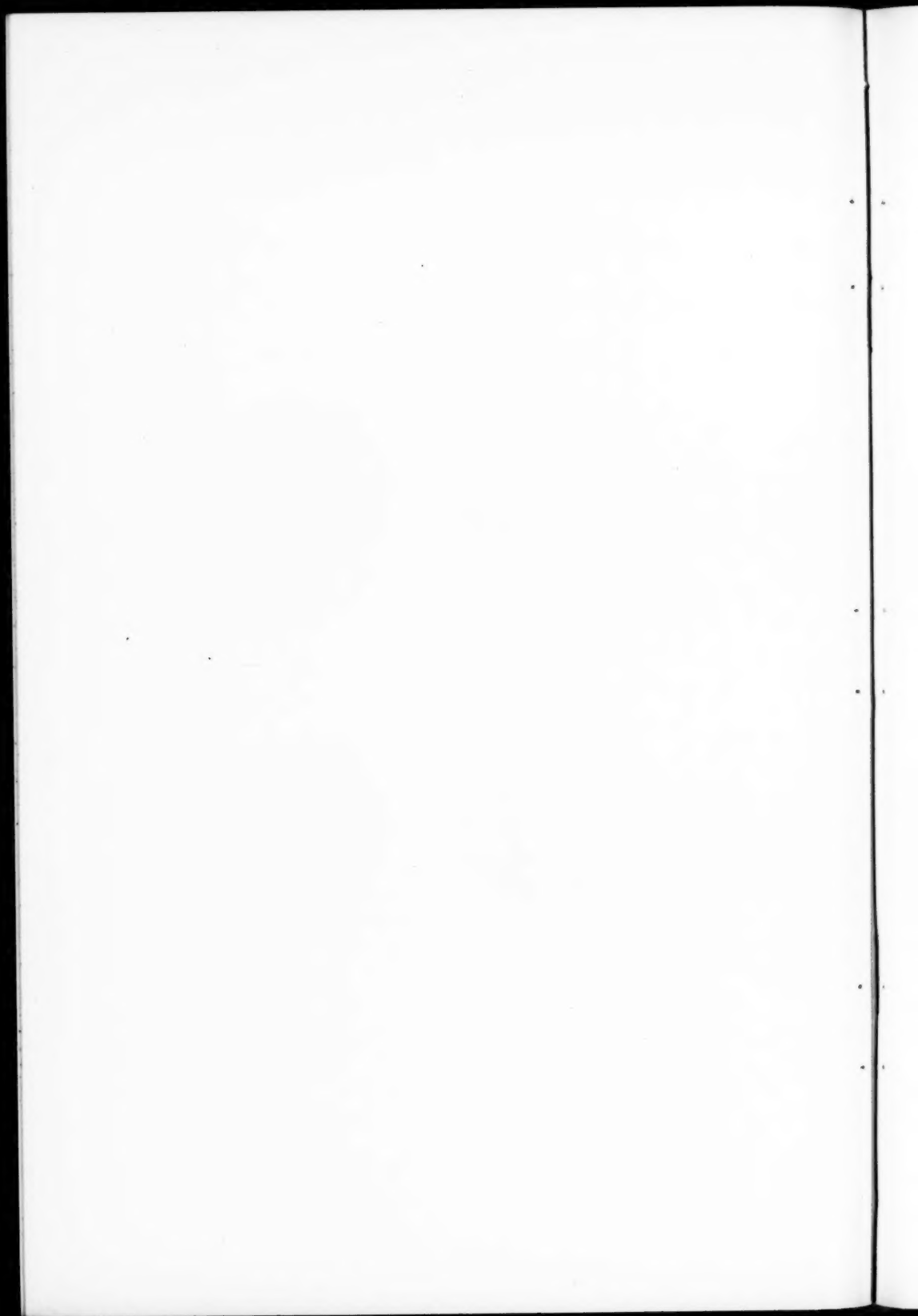
CASE 4. LATERAL DEFORMITY OF NOSE.



Before Correction.



After Correction.



CASE 5. DORSAL HUMP WITH LATERAL DEFORMITY.



Fig. 1-A.
Before Correction.



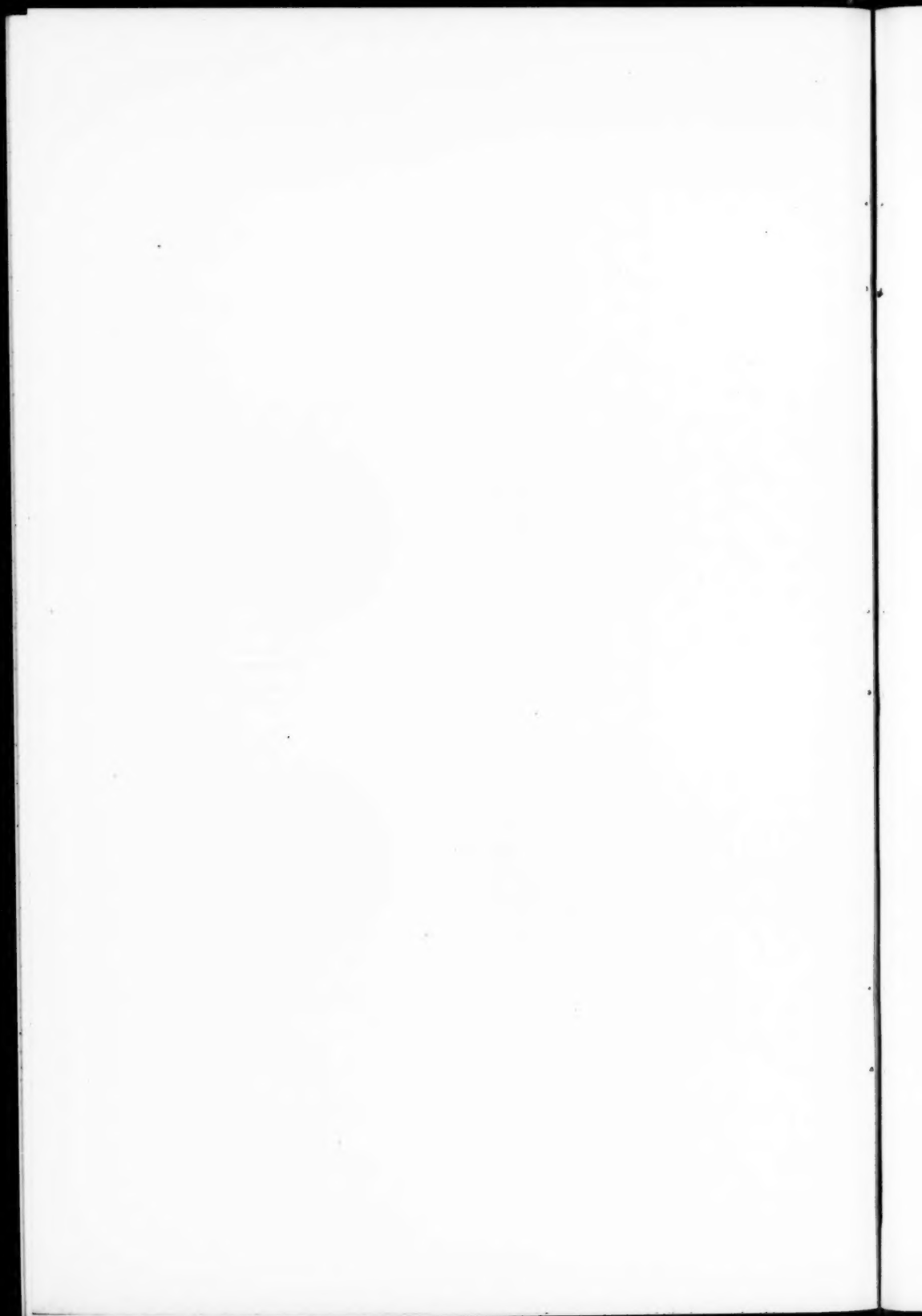
Fig. 1-B.
After Correction.



Fig. 1-C.
Before Correction.



Fig. 1-D.
After Correction.



CASE 6. DORSAL HUMP DEFORMITY.



Before Correction.



After Correction.

CASE 7. DORSAL HUMP DEFORMITY OF NOSE WITH
DROOPING OR ELONGATED TIP.



Before Correction.



After Correction.



CASE 8. WIDE NOSTRILS OR AFRICAN TYPE DEFORMITY
OF NOSE.



Before Correction.



After Correction.

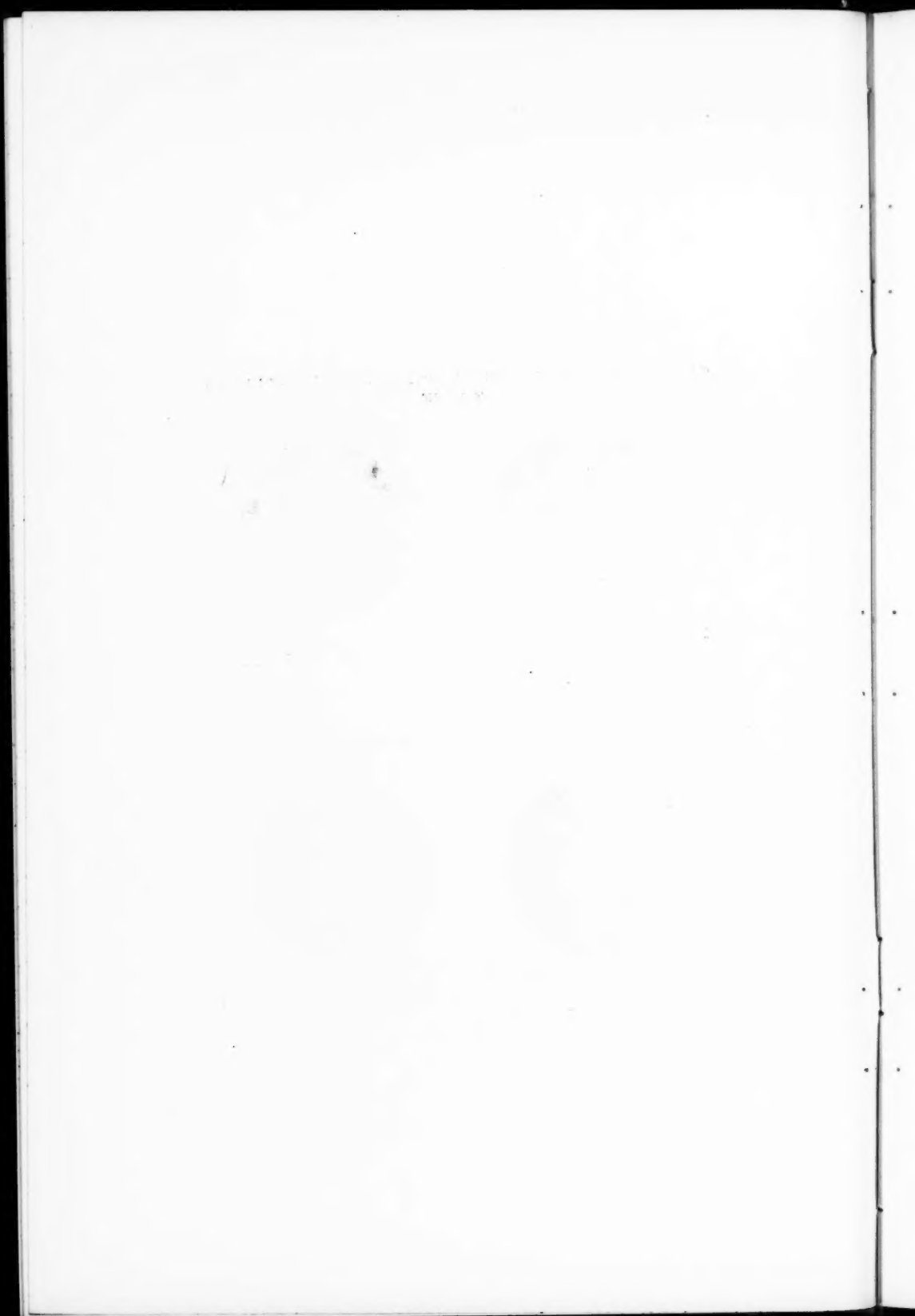
CASE 9. TRAUMATIC SADDLE DEFORMITY OF NOSE.



Before Correction.



After Correction.
By means of cartilage transplant.



CASE 10. CONGENITAL SADDLE DEFORMITY OF NOSE.



Before Correction.

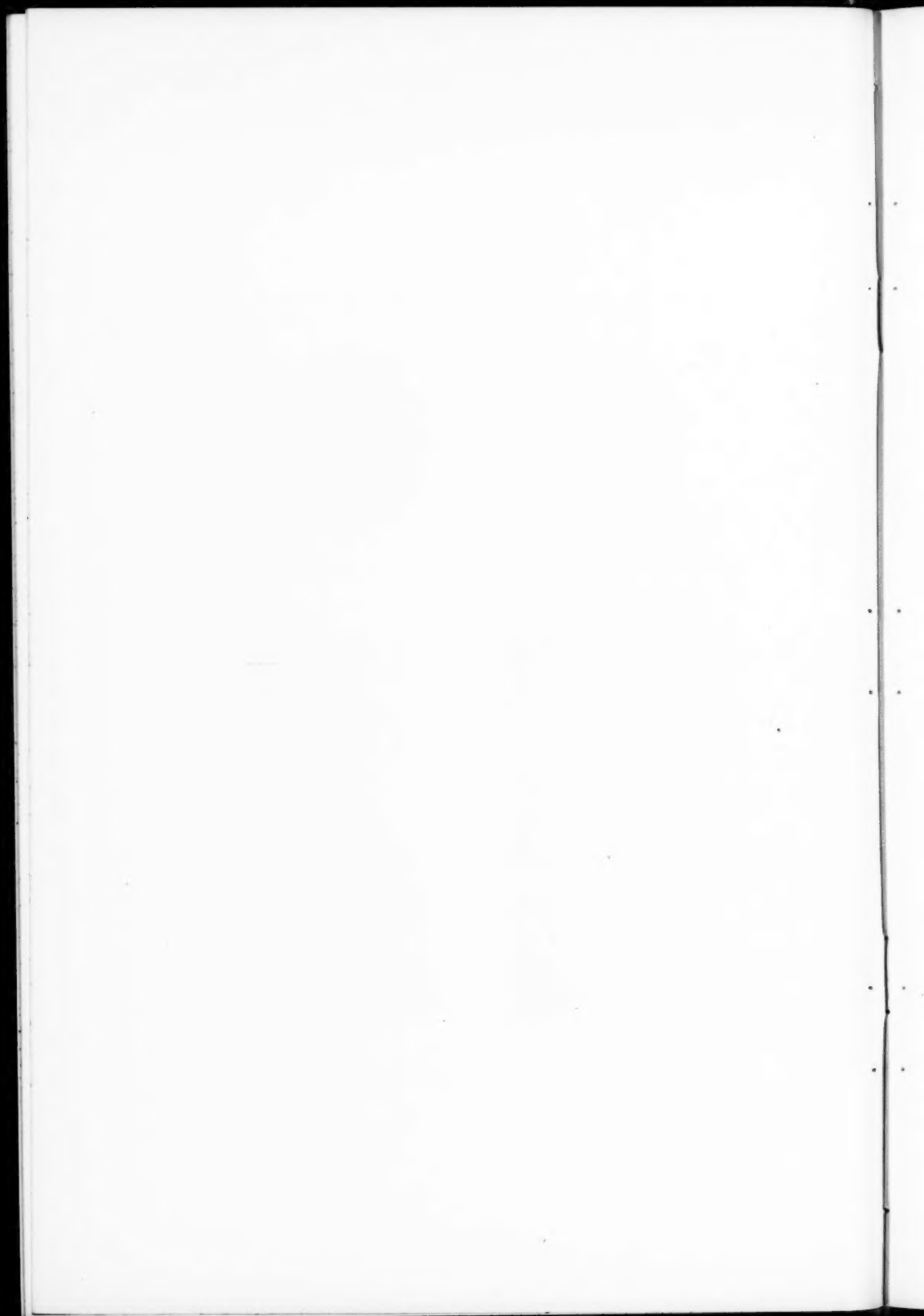


After Correction.

By means of cartilage and bone
transplant.



Radiograph of Case 10 taken four months after transplantation
of bone and cartilage for correction of saddle
deformity of nose.



XLII.

A CASE OF CONGENITAL HEMIMACROGLOSSIA,
WITH DISTURBANCE OF THE LOCOMOTOR
APPARATUS OF THE SIDE OPPOSITE
THE LINGUAL LESION.*

By J. N. Roy, M. D.,

ASSOCIATE PROFESSOR AT THE UNIVERSITY OF MONTREAL;
LAUREATE OF THE ACADEMY OF MEDICINE OF FRANCE,

MONTREAL.

After having made numerous bibliographic researches, in several languages, on the subject of which I am about to treat in this communication, I believe that I may say the following observation is unique of its kind. If we know that acquired macroglossia manifests itself as the result of inflammatory lesions of the tongue—diathetic or others—it is not the same with regard to congenital macroglossia, the cause of which has always been unknown to us. My patient was very interesting from several points of view, in the sense that the case was one of congenital hemimacrogllossia, accompanied by hypertrophy of the corresponding cheek and troubles of the locomotor apparatus of the side opposite the lingual lesion. This association of symptoms particularly attracted my attention up to the point of inducing me to advance a hypothesis to explain by a unique lesion all the phenomena observed. Here is the history of my little patient.

Case Report.—On the 26th of November, 1919, Mrs. C. L., who came from Gaspé, asked me to make an examination of her daughter, three and a half years of age, for a lingual affection dating back to childbirth. She informed me that at that time her baby weighed twelve and a half pounds, and that although the doctor was not obliged to apply the forceps or to practice version, the confinement was very severe. The cord, very voluminous, was long and rolled round the neck. The face was cyanosed, and the tongue, blackish in color, hung

*Read before the 10th International Congress of Otology, Paris, July, 1922.

out of the mouth. In order to reanimate the infant the doctor had to resort to artificial respiration for several minutes. The left cheek was more developed than the right, and it fell lightly on the corresponding lower jaw. There existed certain phenomena of atrophy and paralysis of the upper and lower limbs of the right side. During the five following weeks the tongue slowly diminished in size and recovered its normal color. However, always very large, it protruded from the lips for about two centimeters, and after a lapse of time that condition seemed to remain stationary. The left cheek also became smaller by degrees, but remained projected a little more than the right. The child took the breast with some difficulty.

Six weeks after the birth of the child the parents went to consult Dr. Mireault, orthopedist of Montreal, who was at that time holding his summer clinic on the shores of the Gulf of St. Lawrence, and sought advice in relation to their infant's hemiplegic trouble. My excellent confrère, who subsequently sent his little patient to me for the lingual treatment, was good enough to furnish me with the following notes in relation to his specialty:

"At the examination I noticed that the upper limb and the lower limb of the right side were smaller and shorter than those of the opposite side, which were normal. The arm rested inert along the body, and the leg was without movement. The tissues lacked firmness in the paralyzed regions.

"In that part of Canada nature offers the greatest advantages for the restoration of health, but civilization has not yet carried its progress there; hence we have not yet the assistance of electricity there, either for diagnosis or for treatment.

"The doctor who assisted at the confinement, and whom I met a few days after my first examination, declared to me that he did not find granulations in the membranes or placental tissue.

"The father and mother, who were both about thirty years of age, are in excellent health and do not indulge in alcoholic liquors.

"There does not seem to be either syphilis or tuberculosis in their family.

"They have two other children, both in good health, and whose confinements were normal.

"In face of these symptoms, once a week I carried on massage, accompanied by passive movements of the paralyzed limbs. This treatment was practiced for three months, and at the end of that period a slight mobility manifested itself. The following year I noticed a progressive amelioration. The child could now move the arm and leg. However, these limbs had not yet attained the vigor of those on the opposite side. During this season, as well as during the two following summers, massage and passive movements were continued. I noticed a gradual diminution of the troubles of the locomotor apparatus to the right. The child commenced to walk at the age of eighteen months, and when three and a half years old could run and jump. However, her walking is a little defective, for there is a slight lameness. During the whole period of her orthopedic treatment I never observed spasms or contractions, and the articular movements were executed in their normal amplitude and without pain. There always existed a slight shortening of the right arm and leg, as well as a certain degree of atrophy. These phenomena, with a little natural feebleness of the arm, will be permanent in the future. The tongue and cheek are the only two parts whose condition seems to have remained stationary during the last three years."

At my examination I ascertained, in addition to the symptoms already described, that this girl, having always breathed the pure and saline air of the Gulf of the St. Lawrence, is perfectly developed for her age. The skull, of ordinary size, is well formed and the child's intelligence is above the average.

Her mother informed me that from time to time the child had sudden changes of humor, and even violent fits of temper. However, these cerebral phenomena are becoming less and less frequent. She has never had convulsions.

The left cheek is a little larger than the right, at the same time being very firm.

There is no facial paralysis.

The pupils are normal and there is no nystagmus.

The hearing is excellent on both sides.

The tongue, very thick on the left side, is deviated to the right and constantly hangs out of the dental arcades to a length of nearly two centimeters. Its hypertrophy is uniquely localized on the left side and continues to the base. Of normal

color, it is a little rough to the left, and presents on that side a firmer consistence than on the other. There are no sublingual varicose veins, and the teeth have not produced any ulceration.

The inferior lip is lowered without being increased in size.

The teeth are well implanted, and the gums show nothing out of the ordinary.

The submaxillary glands are not hypertrophied.

The parents have never attempted to force the tongue back into the child's mouth and hold it there by means of a bandage. Moreover, that organ could not be contained in the buccal cavity.

Saliva oozes from the mouth slowly.

There is no paralysis of the muscles of the tongue, and the taste seems to be normal on both sides.

No pain has ever been felt.

The tonsils have not increased in size, and nasal respiration is excellent.

The roof of the mouth is normal.

Mastication is strongly impeded, but swallowing is accomplished relatively well.

Phonation is a little troublesome.

In the presence of this congenital hemimacroglossia, which seemed to have remained in a stationary condition for three years, I immediately proposed the ablation of a part of the hypertrophy as being the most rational treatment. The accepted intervention was fixed for November 29.

Operation.—The little patient was put under the influence of chloroform, and I immobilized the dental arches with a mouth gag. Two tongue forceps were afterwards applied to the end of the tongue—one of them being held by an assistant—and after having practiced a light traction, I divided the organ by means of a pair of scissors for the length of about five centimeters in following the middle raphe to the left. Once the tongue was separated in two, the affected side being longer than the healthy side, I removed a V shape piece in order to reestablish the symmetry. The section commenced on the left external part, at a certain distance from the tip, and continued towards the base on a line of four centimeters. After having controlled the hemorrhage, which was insignificant, I made a series of sutures commencing at the wound on

the floor of the mouth. When all the points were placed I applied a last transversal suture having the form of a U to properly coapt the middle part. At this time the tongue entered the mouth perfectly, and its tip, which was drawn neither to one side nor to the other, maintained its regular anatomic design.

As a buccal antiseptic I prescribed a solution of resorcin to be used with an atomizer.

The outcome of the operation was normal, and after several days of lingual reaction the edema disappeared gradually. I commenced to make the ablation of the sutures at the end of the first week, and on the eleventh day they were all removed. Three weeks after the intervention the girl, thoroughly well, returned home with her mother. The left side of the tongue was still a little larger than the right; however, its volume diminished little by little.

The anatomicopathologic examination of the piece that was removed showed that we were in the presence of a hemimacroglossia of lymphatic form—a microscopic variety most generally observed in this kind of lesion of congenital macroglossia.

From time to time I received news of my little patient, and in June, 1922, the left cheek was of almost equal volume to that of the right cheek. The left side of the tongue was slightly larger than the right; however, it was quite mobile and easily contained in the mouth. Considering the age of the child, her pronunciation was as good as could be expected and her temper was improved.

As it is now a little more than two and a half years since the operation was performed, I have every reason to believe that there will not be any relapse of the lingual affection.

The upper and lower limbs of the right side are still slightly shorter than those of the left, and at the same time present a little atrophy. These troubles will never wholly disappear in the future.

To sum up the case, a child born of parents enjoying the best of health, without any diathesis, has at birth a hemimacroglossia to the left, accompanied by hypertrophy of the corresponding cheek, and paralytic phenomena of the locomotor apparatus on the side opposite to the lingual lesion. After

the operation the tongue and cheek returned to an almost normal condition, but the motor troubles of arm and leg, though very considerably improved, did not entirely disappear.

If now we stop to consider the cause of this strange disease, we see that in the orthopedic domain the etiologic factors of the locomotor troubles of newborn children can give rise to very different interpretations, according to their localization.

Lesions of the nervous system are more serious than articular lesions, and the contusions of the muscles do not give a prognosis as serious as in the case of epiphysary tearing.

Affections of newborn children resulting from abnormal conditions during the intrauterine life manifest themselves at birth or in the first days after confinement.

Tissues in the course of growth are very vulnerable, and their power of resistance is less during intrauterine development than on the nursing child.

Our slight knowledge of fetal life does not give us an entire comprehension of abnormal phenomena, mechanical or nutritive, which have for result a being infirm or deformed when brought into the world.

There are three classical types of congenital paralysis. The whole three affect only the arm. The first paralysis attacks the entire arm; the second, that of Klumpke, settles in the forearm; and the third, the paralysis of Erb, occupies the upper region, the latter kind being much more frequent.

But apart from the present instance, we have never yet observed a case of congenital paralysis of the lower limb.

The totally transitory paralytic character of the troubles of the patient in this case inclines me towards two etiologic factors: either a bulbar capillary hemorrhage or in the nervous trunks, or else a traumatism of the articular capsules due to a slight and prolonged traction on that membrane by an exaggerated flexion during the last days of intrauterine life. Nevertheless, I must say that the arm and leg both participated in the state of paralysis, that there was neither contractions nor bad positions of the limbs, and that symptoms of pain were absent.

As to epiphyseal tearing, it must be eliminated.

The cause of congenital macroglossia is not yet known.

In my case, I believe the hemimacroglossia can be attributed

to the same etiologic factor as the affection of the locomotor apparatus. Indeed, if we had been in the presence of a cerebral lesion, there would have been the phenomena of contraction, pain and sensory troubles. None of these were present, and, more than that, the intelligence remained lively, the character became normal and physical development followed the ordinary course of growth.

With a meningeal edema there would probably have been persistent lesions being connected with a diathesis.

Consequently, in the presence of the association of symptoms observed in the case of my little patient, I consider I found sufficient elements to justify the hypothesis of a bulbar capillary hemorrhage in the region of the nuclei of the seventh, twelfth and ninth cranial nerves on the left side, a lesion which determined a trophic trouble of the tongue and cheek, accompanied by divers troubles, transitory or permanent, of the upper and lower limbs on the side opposite the lingual affection.

716 ST. HUBERT STREET.

XLIII.

SINUSITIS FROM SWIMMING.

By RALPH A. FENTON, A. B., M. D.,

PORTLAND, OREGON.

With the very great increase of public interest in swimming, diving and the use of public tanks and bathing places, it is often alleged that disease is spread by such resorts. Spasmodic efforts to regulate public baths have been succeeded by a rather coherent policy of water examination by health authorities, and by insistence upon preliminary showers, provision of heat sterilized suits, as well as chlorination, ultra violet ray treatment, and other bactericidal measures for the water itself.

Nevertheless the incidence of ear, nose and throat disease following swimming is still commonly noted by rhinologists and is often blamed upon dirty water. Certain fallacies in this generalization have caused us to examine statistical findings in our own city and in other fields, and to present a series of typical cases, so that free discussion of the subject might occur before this academy.

The bacterial content of public tanks in Portland runs from 30 to 4800 per cc.;¹ that of the Willamette River as it enters the city limits after traversing a populous valley for 135 miles is, in June 600 per cc.; the river water offshore from the mouth of one of the city's largest sewers contains only 2,000 per cc.² Published figures for the River Thames are from 277 (April) to 2,075 (January); for the Illinois River at Ottawa, 6,300 to 8,200 (May); and for the Mississippi at New Orleans, 805 (August) to 3,597 (April).³ The initial purity of Portland's drinking water, which plates sterile throughout the year, and is brought thirty-five miles from a closed forest reserve near Mount Hood, doubtless is responsible for the low tank figures. No sewage infection was found in tanks or river. It is of course relatively hard to grow for differentiation of the bacteria toxic to human beings, from the ordinary counting plates; for accurate identification animal experimentation is necessary, and not much work has been done in this

field. Overgrowth of these germs which are viable in cool water for long periods, not requiring warmth or serum media for favorable growth, is responsible for much of the negative information regarding human disease germs in water. But, by the same token, it is scarcely possible to conceive that human germs of highly toxic action upon the respiratory mucosa can multiply under conditions prevailing in swimming tanks, rivers or lakes. Low temperatures, unfavorable media, antiseptic agents and the action of air and sunlight upon agitated masses of water assure the subdivision and disinfection of most of these contaminations. Samples from various depths count very much the same.

J. W. Robinson⁴ mentions certain effective rules of the California State Board of Health, requiring that proper and convenient places for expectoration by bathers be provided; that surface contamination shall be skimmed off; that the water shall flow off at various levels continuously; and that all persons known or suspected to have infectious diseases shall be excluded. He asks pertinently who will do the excluding, and, in common with Walker,⁵ suggests enactment of law making it a misdemeanor for an infected person to enter a tank.

A committee of the American Public Health Association has recently reported upon a questionnaire regarding bathing places, which had been sent to 2,000 eye, ear, nose and throat specialists. Tanks were considered important means of spreading "colds" by 67 per cent of the 600 men who made detailed answers. Sinus infections were reported by 72; one man reported an epidemic of sinusitis. One hundred and forty-five cases of otitis media were reported; 4 cases of meningitis were attributed to nose or ear complications. (It is of course likely that many cases reported as simple "colds" were really acute sinus or ethmoid infections.) The whole difficult matter of protection of tank water and of testing for the germs of upper respiratory and conjunctival disease was referred to the laboratory section of the American Public Health Association for report at this year's meeting.

From our own cases we have selected four rather typical examples of infections following swimming which will be reported briefly:

1. Acute left ethmoiditis and maxillary sinusitis; latent chronic left frontal sinusitis; frontal lobe abscess; bilateral jugular thrombosis. Fatal.⁷

N. L., white boy, 19, referred by Dr. R. B. Stephenson of Centralia, Washington, who had opened his left ethmoid, removed part of the left middle turbinate, and washed out his left antrum. This had been done because of severe acute sinusitis with frontal headache, following upon several months of swimming and high diving, mostly in rivers and stagnant ponds, never in a public tank. Yellow pus flowed freely after this drainage, from the left frontal, with temporary remission of symptoms. In a few days, however, temperatures to 104 and upper lid edema pointed to orbital extension, and Dr. Stephenson brought him to Portland. Frontoorbital radiographs were inconclusive.

An extensive Luc-Hajek external frontal operation was done at once, October 13, 1920. Free nasal drainage was found, and it was assumed that a tendency to point toward the external angular process through the upper lid would cease, following the open nasal channel. Temperature went down to 99 for a day or two, but speedily rose to 104 and over, with a relatively slow pulse. The optic discs were somewhat choked, especially in the left eye, so that after negative lumbar puncture diagnosis of frontal lobe abscess was made. Cord-like swelling and sternomastoid soreness, with a white count mounting to 17,500, 87 per cent polymorphonuclear, caused the suspicion of right jugular thrombosis.

The entire inner wall of the left frontal sinus was removed October 23, 1920, by Dr. Dillehunt, opening a large epidural abscess which gushed out under pressure, accounting for the constant flow of pus into the nose through dehiscences not found at the first operation and also for the fistulization toward the outer side of the orbit.

Metastatic lung involvement was expected; the jugular soreness became bilateral. Fibrinous pleuritis and bronchopneumonia became manifest, especially on the right side. Remarkable stimulation was produced by several intramuscular injections of whole blood by Dr. Bean. The patient's mental condition remained bright at all times. Some herniation of the

frontal lobe took place, partially collapsing the half centimeter soft rubber drain through which dichloramin oil had been injected daily with almost complete cessation of the yellow discharge. A stiffer tube was used, but about three weeks after the brain abscess was drained heavy grumous bloody material escaped one morning, and it was feared that this meant an extension of infective thrombosis beyond the abscess area. Next day the right arm was paralyzed, and aphasic phenomena and semicoma a day later mapped out the march of meningeal invasion. Death came on the 27th day postoperative.

Postmortem by Dr. Menne the same evening disclosed an abscess extending vertically about 8 cm. from the left orbital roof and diagonally to the right across the longitudinal sinus, eroding the inner table of the frontal bone about 2 mm. The entire left hemisphere was compressed by a quantity of pus filling the dural cavity. Pus had burrowed through the orbital roof, traveled subperiosteally toward the outer angle, to appear under the eyebrow. There was no pus in the ethmoids, maxillary antra, sphenoids or right frontal.

Most unusual was the finding of complete and organized right lateral sigmoid and jugular thrombosis and incomplete organized thrombosis of the left sigmoid and jugular. There were hundreds of lung abscesses, also bilateral coalescing bronchopneumonia, marked acute hemorrhagic and fibrinous pleurisy, acute tracheobronchial lymphadenitis and marked cloudy swelling of the parenchymatous organs. The chief organism involved was a hemolytic streptococcus.

2. Acute left ethmoiditis; orbital cellulitis; coma; radical external ethmoid operation; recovery.

A. K., white boy, 11, poorly nourished, sent in to Multnomah Hospital September 16, 1920, on account of pain and swelling over left eye following swimming in river about a week previous. Lids were swollen one day prior to admission. Temperature was 99.8, leukocytes 11,000. Acute anterior ethmoiditis was diagnosed, and as it did not improve with saline hot nasal irrigations and seemed to be pointing toward the inner end of the left upper lid, this region was incised freely, September 29, with discharge of much staphylococci pus. The fistula came from the anterior ethmoid, and

washed readily down into the nose. Under dichloramin oil irrigation this fistula ceased to discharge pus after two weeks, and as the temperature remained normal he was taken home November 1.

Thirty-five days after the first incision, on November 5, he was brought back, very dull mentally, temperature 99, white cells 13,000, pulse 68. The ethmoid still showed dark in the radiograph. As the temperature rose slightly the pulse reached 62 and 64. Radical external ethmoid was done on the left side, November 8, opening the posterior cells freely. There was little pus in front but much in the posterior group.

The highest postoperative temperature was 100.8, next day; the semicoma disappeared at once. Diplopia persisted for ten days. This boy left the hospital well two weeks after the radical operation and is still well; he has quit swimming.

3. Acute left ethmoiditis; orbital cellulitis; double frontal sinusitis; external radical frontal and ethmoid operation; exposure of dura; recovery.

A. H., white boy, 12, robust, admitted to Multnomah Hospital December 12, 1921. This lad had suffered from pains in his face and over his eyes following diving during the preceding summer. He had been sick for two months, and a swelling over the left eye had been opened by a neighbor, four months before admission. Yellow streptococcic pus had discharged from the fistula since. Temperature was 97.8, pulse 74, white count 9,500; radiograph showed dark left frontal, with no apparent frontal involvement.

Radical external left ethmoid operation December 15, 1921, by Dr. Lupton. There was little posterior involvement, but a rather large left frontal, placed almost horizontally, with no extension upward into the frontal bone, was found to communicate directly with the right frontal. The partition between was loose, coming away as a sequestrum. An area of dura 1 by 2 cm. was exposed above the left frontal.

Postoperative temperature ran from 97 to normal. There was no diplopia, and the boy left the hospital nine days postoperative and has been well since his discharge from office care a few weeks later.

4. Chronic right maxillary sinusitis; chronic bilateral ethmoiditis; chronic catarrhal otitis media. Acute exacerbations; radical antrum and internal ethmoid operations; recovery.

M. W., white woman, 32, an expert swimmer and exhibition diver for some years, had been troubled with head discharges for several months prior to the autumn of 1919; hearing grew worse after each season of diving. She liked to dive because it "cleared out her head," but she was always careful to expectorate mucous into the side gutters of the tanks. Her frontals were clear, antra and ethmoid dark. Free foul curdy pus was irrigated out of the right maxillary, which yielded to treatment only to recur promptly whenever she began diving.

Radical right antrum (Luc-Caldwell) was done January 17, 1922, with removal of much polypoid mucosa and prompt recovery. The streptococcus predominated in this infection. In spite of frequent warnings she swam a few times more, causing such ethmoid exacerbation that double Mosher ethmoidectomies were done in June, 1922.

Practical cessation of pus has already taken place; the patient has already gained fifteen pounds and hears about 10 per cent better than before the radical antrum. She does not swim now.

Such cases have abounded in the literature, but have infrequently been ascribed so clearly to swimming and diving. Cobb,⁸ in 1908, stressing the fact that those who take tub baths do not put their heads under the water, cites a boy of 15 who developed ethmoiditis after five visits to a public tank; a man of 20 with acute otitis media; and a boy of 14 with double ethmoiditis and double suppurative otitis, having tender mastoids. All recovered and remained well when they stopped swimming.

Wilkinson⁹ in 1912 and Hope¹⁰ in 1914 cited a number of cases before the Royal Society of Medicine.

Wilkinson reports a man of 19, with frontal sinusitis existing for two years following diving; a woman of 32, with a suppurating maxillary antrum for six months following a "ducking" in a public tank; a boy of 17 with chronic ethmoiditis who returned from the seashore with an "orbital abscess"—osteomyelitis of the frontal bone, both frontals filled with

pus, bilateral subdural abscesses, left frontal lobe abscess, and death two months later; and a boy of 15, delirious, with "orbital abscess"—double frontal; "pyemia of the lungs", following one day after swimming in baths, and fatal one week later. The discussion turned upon strong prohibitory measures against permitting children with nasal discharges to enter public bathing places, even at the seashore. Hope reports two frontal cases: a man of 20, swimming four days before, orbital pain and swelling the next day, found to have a maxillary antrum and an orbital abscess with fistula down from the frontal floor. Discharge recurred until a radical Killian was done, when the dura was found exposed, two months later; well after three months. His second case was a girl of 14, of similar history. Polypoid granulations pointing to chronic involvement were found on her dura where exposed. This case had no maxillary involvement. It was developed that both these cases dove feet first and was again maintained that no person with an existing nasal suppuration, however mild, should swim in a tank or pool.

The normal protective mechanism of the sinuses, as stated by Skillern,¹¹ includes (1) the ciliated epithelium, with its wavelike action toward the ostia, and (2) the inhibitory action of sinus secretion upon germ growth.

Swimmers and divers introduce the following factors which interfere with this protective apparatus:

1. Destructive action of plain water upon cells, by osmosis, drawing out saline elements, causing edema and acidosis of cells, loss of ciliary activity and eventual cell death. This "irritative action of water" causes lowered local resistance. The specific protective substance of the sinus secretion is diminished and eventually lost by being forcibly washed away and later inhibited by the edema and chemical degeneration of the secretory cells.

2. Washing into the sinus of pathogenic and saprophytic germs from the more highly immunized direct airways of the patient's own nose and throat; retention of these pathogenic germs in a warm cavity lined and often closed off by edematous cells with impaired resistance. The germs of vegetable decay found mainly in water, multiplying by preference at low temperatures and in the open air, must not be considered to

have much to do with sinusitis. Nor is it wise to assume that germs from other persons are directly to blame in all cases. Too many people swim alone or in large bodies of outdoor water and are nevertheless infected. Contamination from other swimmers directly is made less likely by the coolness of the water, its constant agitation, and the consequent high dilution of sputum found in it. The assumption that most persons succumbing to sinusitis after swimming are poisoned by their own nasopharyngeal germs, mechanically driven into these cavities under conditions favoring rapid growth and retention of secretions, has much justification.

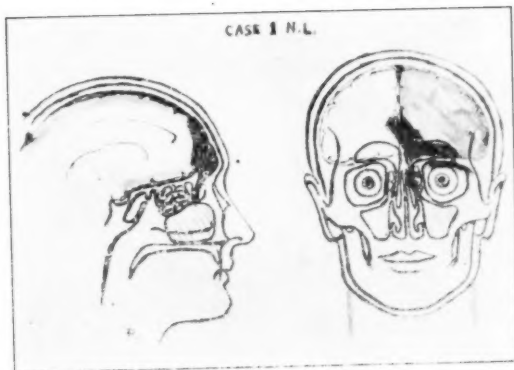
3. Direct trauma to ostia, to mucosal linings and to bony dehiscences by forcible inrush of water, especially if chlorinated, and by the forcible outrush of air bubbles. Increase of pressure in deep diving, with the bubbling and squeaking and persistent headache reported by certain swimmers, must also be reckoned with.

Prevention of sinusitis from swimming would seem to be largely a question of warning those with latent nasal infection, "chronic colds" and the like, to keep out of the water. Warnings of danger to the individual are far more impressive than warnings of danger to others; there should be an appeal to self-interest. People with high narrow noses, occlusive deflections or impinging middle turbinates are all dangerous swimming risks. Persons with nasal discharges, "colds" and "catarrh" must be warned of their own danger by strikingly worded placards. Let them stay out until they are well. Operative prophylaxis might include measures to free the drainage of all sinuses; infraction or partial resection of middle turbinates, submucous septal resections, removal of agger nasi or bullar ethmoid cells. Osteal occlusion by swollen mucosa should be made impossible. Heavy paraffin oil may be dropped in the nose before swimming. Deep diving should be forbidden to all whose sinuses are large and ostia small.

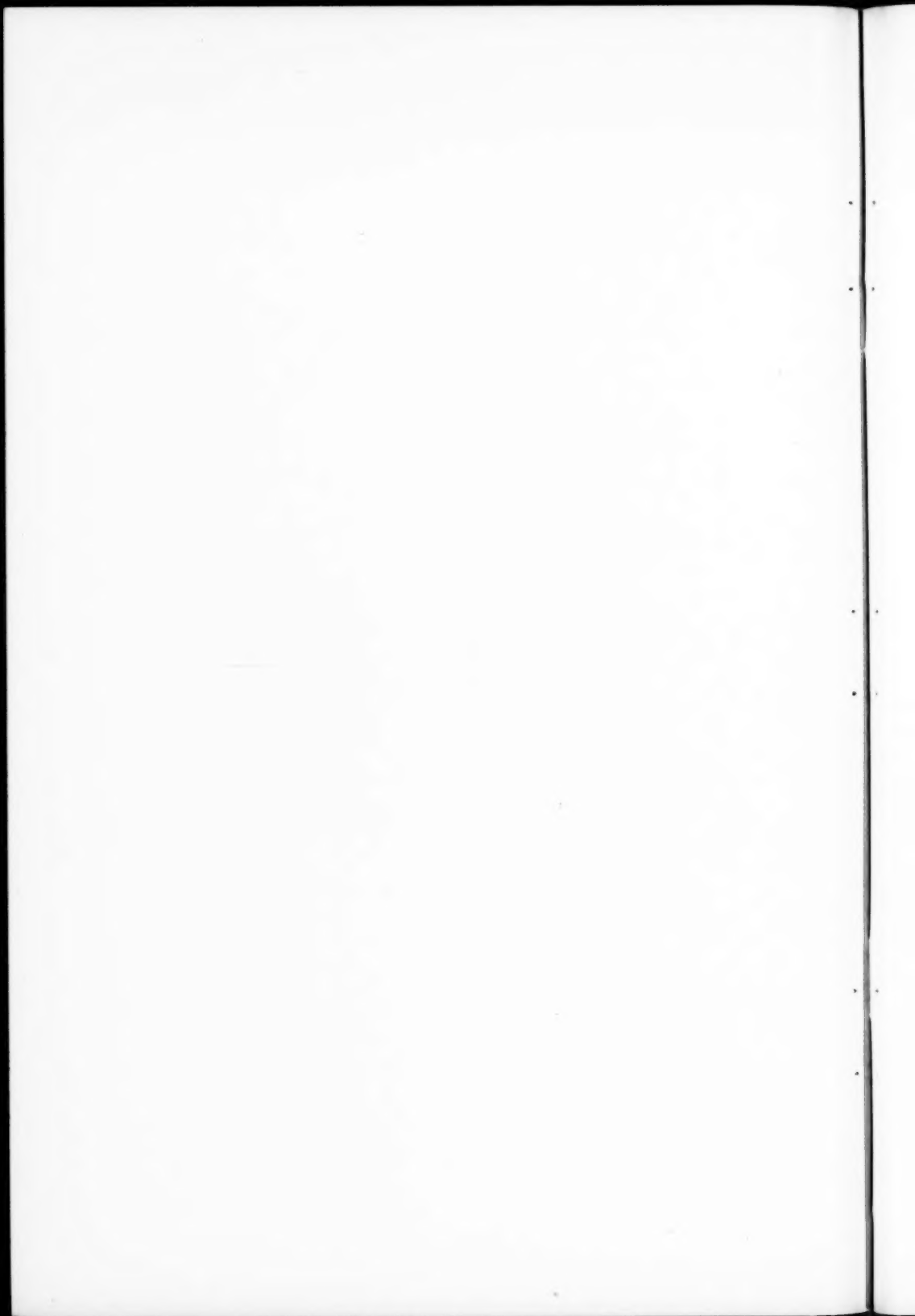
It would seem that in harmony with the work of the laboratory section of the American Public Health Association, this academy might well advise the profession and the public regarding these safeguards and dangers of diving and swimming.

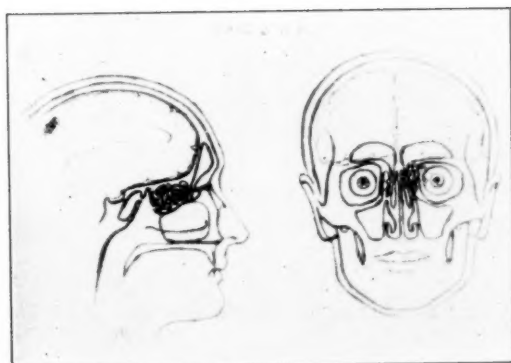
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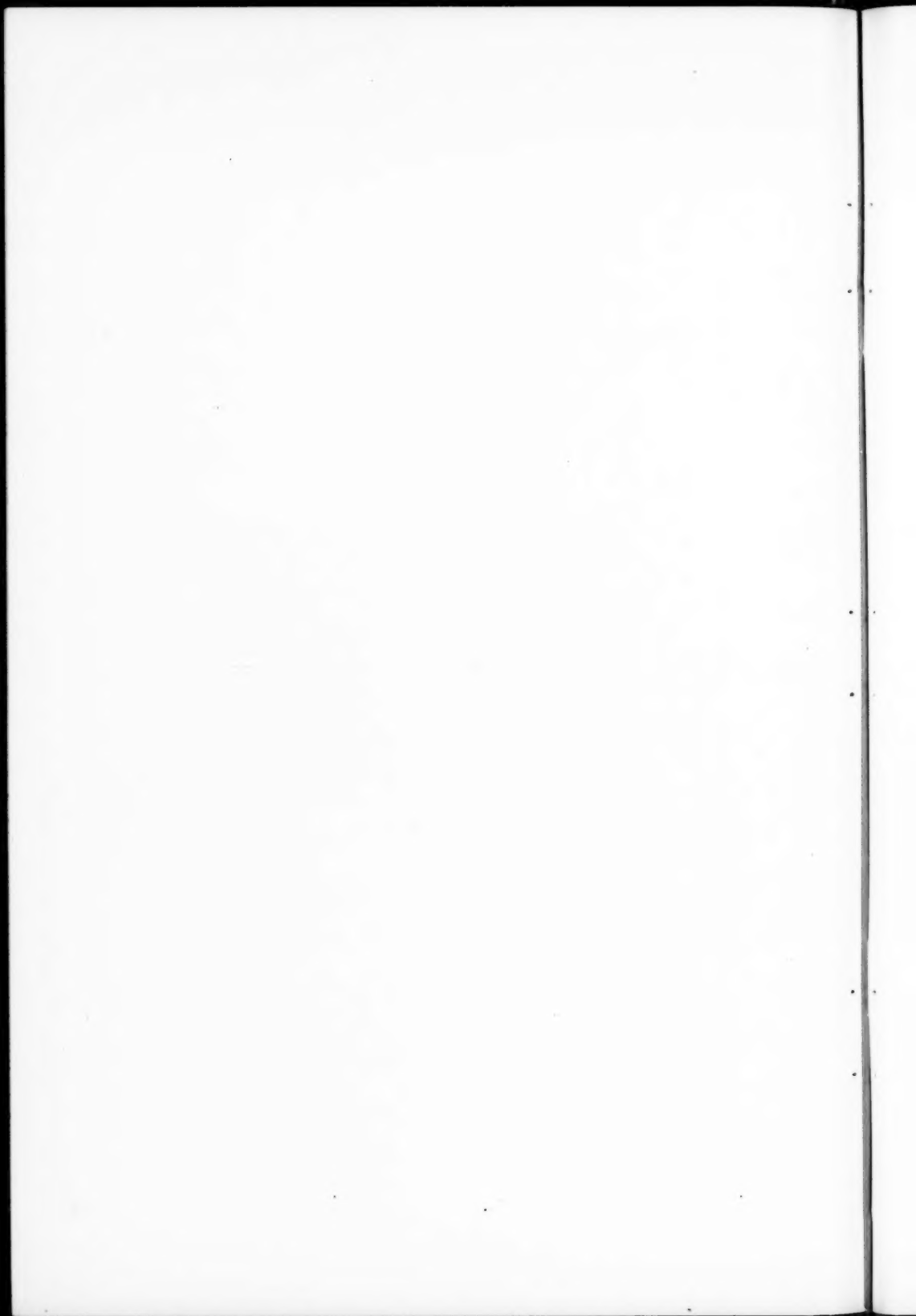


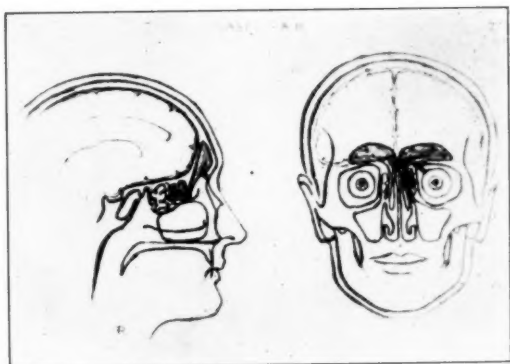
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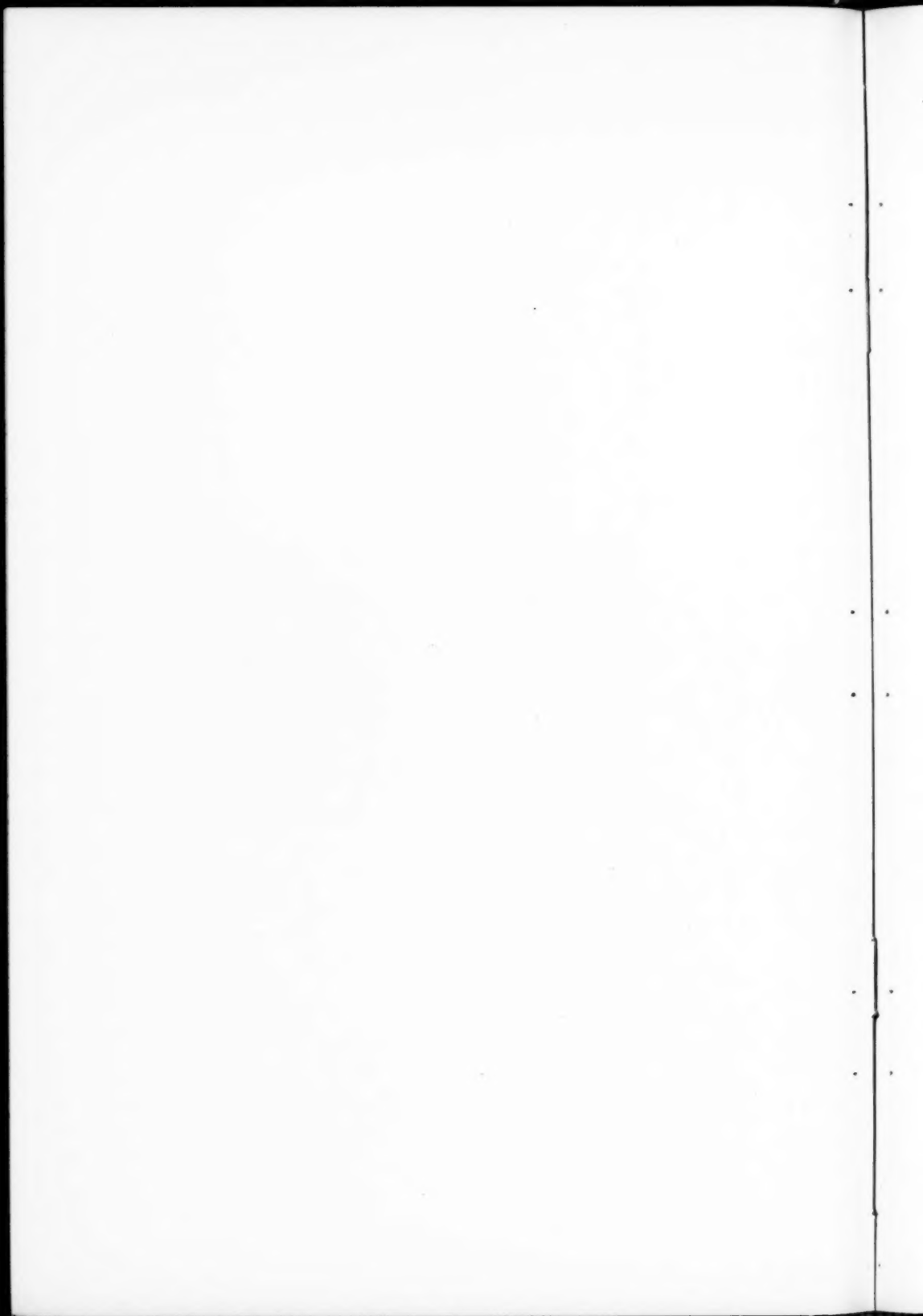


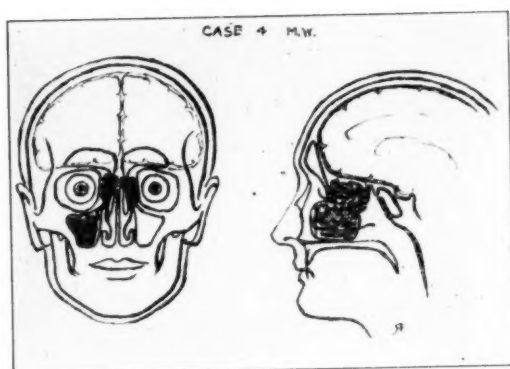
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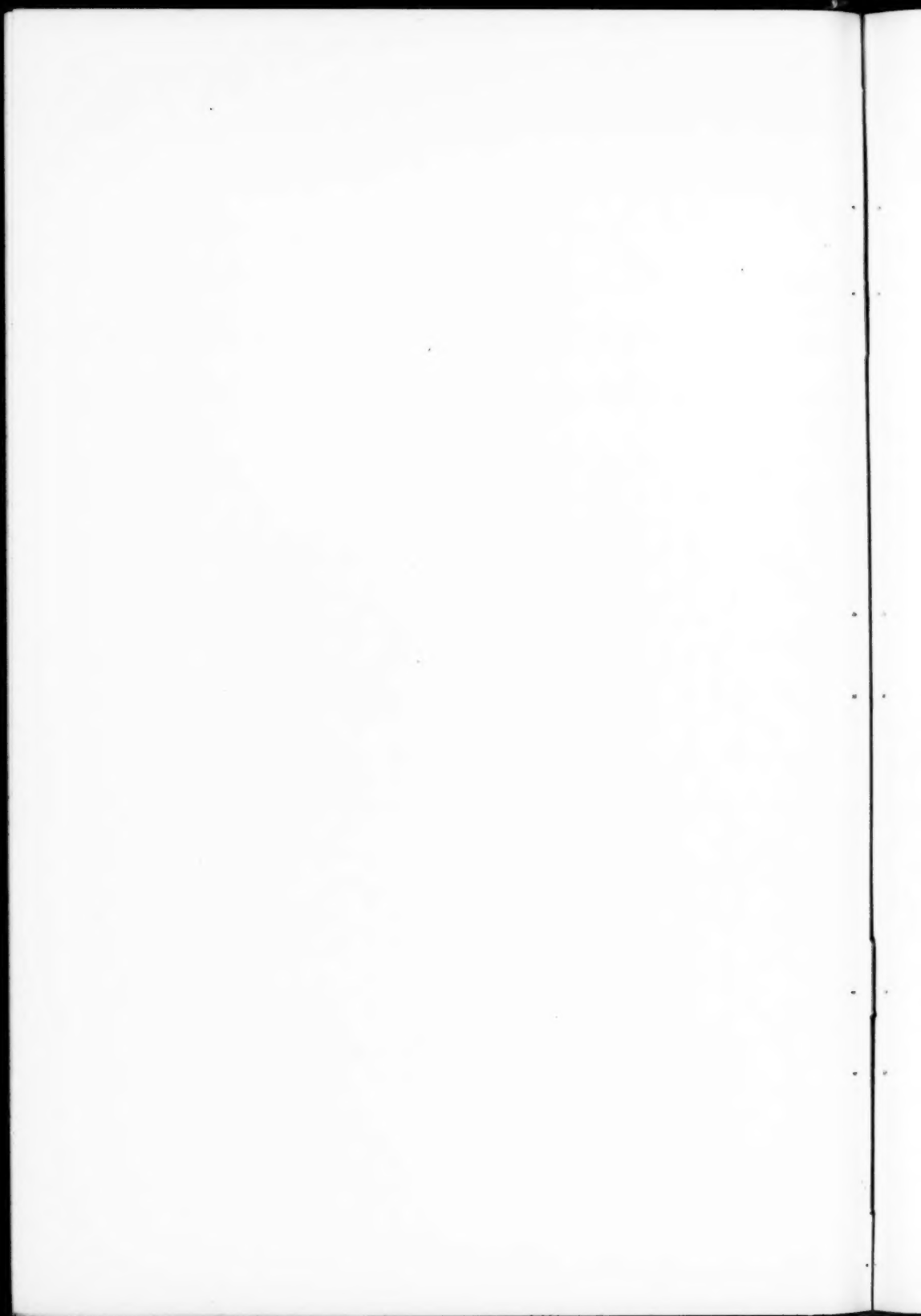


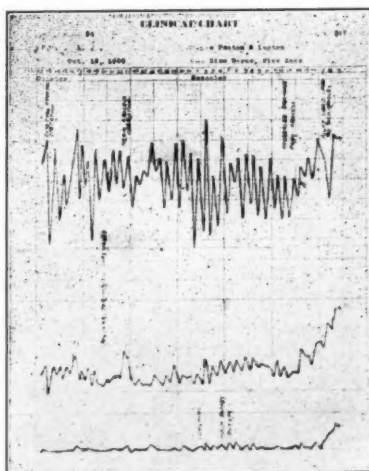
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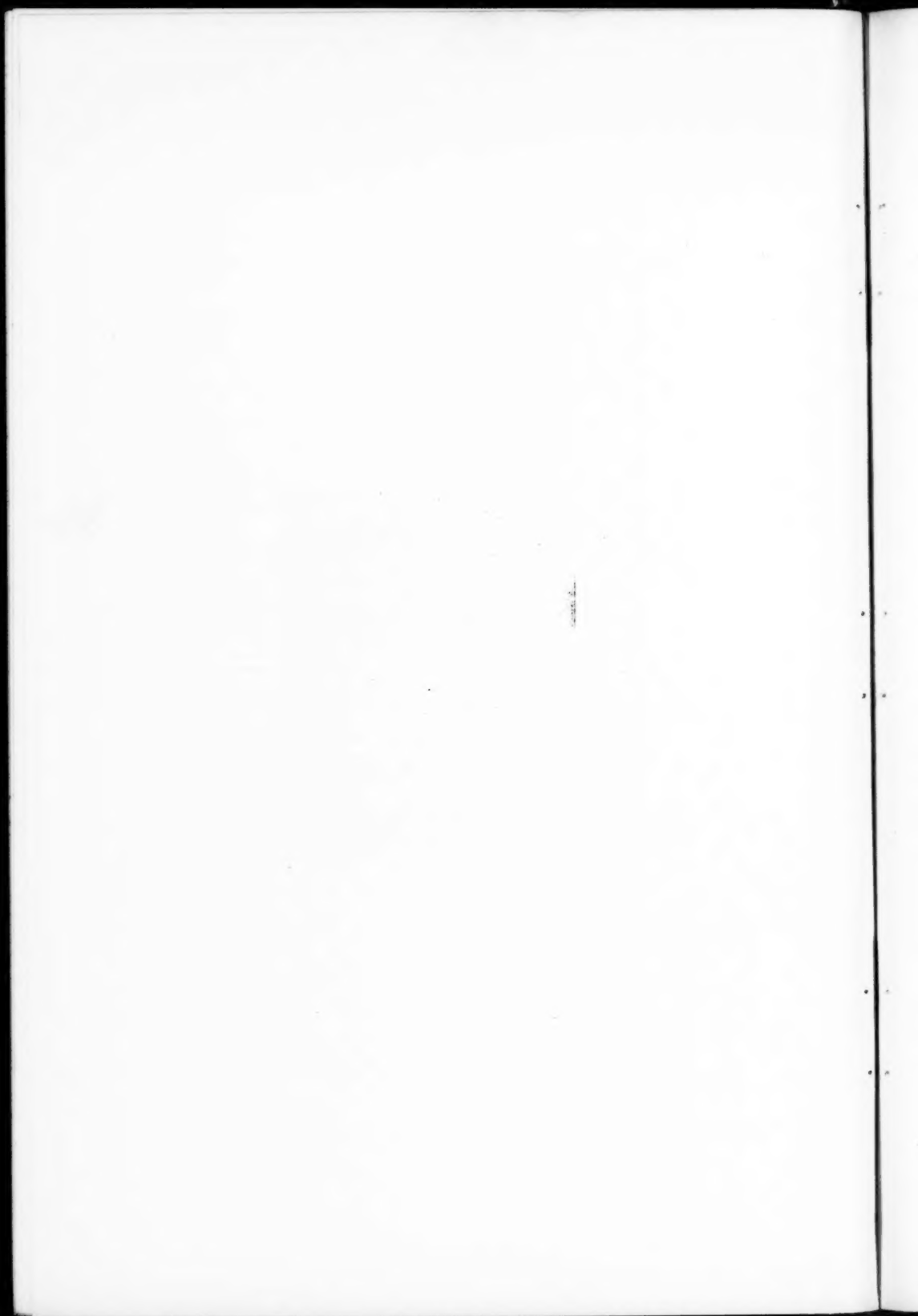




Case 4.







XLIV.

THE EFFECT OF PRESSURE CHANGES IN THE
EXTERNAL AUDITORY CANAL ON ACUITY
OF HEARING.*

BY AUGUSTUS G. POHLMAN, M. D.,

DEPARTMENT OF ANATOMY, ST. LOUIS UNIVERSITY,

AND

FREDERICK W. KRANZ, PH. D.,

WALLACE CLEMENT SABINE LABORATORY OF ACOUSTICS,

RIVERBANK LABORATORIES, GENEVA, ILL.

The advantage of collaborative research is clearly indicated in problems connected with the sense of hearing. It is only through applying the recent advances made by the physicist to the structural conditions as established by the morphologist that the details in the mechanics of sound transmission from the drum membrane to the end organ may be properly investigated. This paper, as well as others to follow, has been made possible through the courtesy of Colonel George Fabyan of Riverbank, Geneva, Illinois. The physical material is contributed by Kranz, and the physiologic aspects, both subjective and objective, are by Pohlman.

Up to the present no satisfactory method has been devised for testing acuity of hearing in any form of animal excepting man himself. This fact necessarily places a limit on the possibility of experimental work. The most sensitive type of physical apparatus for the detection of sound is illustrated by the Webster phonometer. The moving member in this instru-

*Note.—The problem of middle ear mechanics was to have been discussed in three chapters, two of which have appeared in this journal. Since writing the first two articles the writer has associated himself with the Riverbank Laboratories, where facilities have been developed for the quantitative determination of both air and bone transmitted sound. The third paper will be deferred for this reason until the researches on the acoustic insulation of the labyrinth and the investigation of bone transmitted sound in reference to the usual otologic tests have been completed.—A. G. P.

ment is a small disc diaphragm supported in the mouth of a resonator by three tension wires. The tension of the wires and the size of the resonator are so regulated that the moving diaphragm and the resonator have the same natural period. The diaphragm is therefore very sensitive in its response to tones of this frequency, and by means of a projecting pointer the diaphragm motions are converted into torsional vibrations of a vertical tension wire upon which a small mirror is mounted. Vibrations of the diaphragm and so also of the mirror cause a change in the width of a beam of light reflected from the mirror into a ruled ocular eyepiece. The intensity of the sound, within certain limits, may be determined from the width of this band. The instrument, being carefully tuned, is useful for only one frequency.

The sound transmission mechanism of the ear, on the other hand, is an entirely different type of apparatus. It is not tuned to any particular frequency and does not possess a resonator to reinforce the different sound pulses impinging on the drum membrane. The element to be moved is not a minute mass with a definite restoring force and operating only upon another light mass, as in the mirror of the phonometer. The hinged bony apparatus of the ear is relatively heavy and not only does not present the definite restoring forces noted in the phonometer; moreover the system operates against a column of water (endoperilymph) in the inner ear.

The drum membrane presents a diaphragm which is flanked by air on both sides. Unlike the diaphragms used in the physical laboratory, this membrane is not flat in either birds or mammals. The mammal presents the typical umbo-in picture found in man, while in birds the drum membrane is convexed outward into the external auditory canal. Reptiles, like turtles, have slightly convexed drum membranes, which are composed of hyaline cartilage and directly continuous with the extra columella. The cartilage plate is always closely adherent to the overlying skin and loosely attached at its periphery to the adjacent head bones. The tailless amphibians also possess a surface drum membrane which is considerably thickened and which contains many smooth muscle fibers.

The middle ear as a moist vascular area shows the property of absorbing the contained air so long as the gas tension in this

cavity is in excess of the gas tension of the blood lymph system. There is no evidence that the drum membrane is permeable to air, and neither is it likely that the mucous membrane of the middle ear can actively secrete gases after the manner of the air bladder in fishes. Accordingly, in continuing the comparison with the phonometer, while this instrument operates with equal normal air pressure on both sides of the disc, this condition does not obtain for the drum membrane. The recent work of Fowler¹ demonstrates the presence of a slight normal negative pressure convincingly. This is in agreement with what is commonly accepted and is opposed to the contention of Secchi², who holds for a plus pressure, and of Wrightson,³ who figures the pressure on both sides of the drum membrane as equal.

It is also well known that in cases of prolonged closure of the tuba auditiva, the absorption of air from the middle ear results in retracted, hypertense drum membrane, accompanied with a conspicuous decrease in the acuity of hearing. In these cases insufflation of air into the cavity of the middle ear through the tuba auditiva not only relieves the condition of the drum membrane but also has a pronounced effect on the deafness. It is also common knowledge that some individuals suffering from tubal occlusion claim they hear better on rainy days than on bright clear days. They hear better when the barometer is low. Cases have also been reported where certain deaf people have had acuity of hearing improved, perhaps only temporarily, as a result of rapid ascent of high mountains or in altitude climbs in an aeroplane. These cases may apparently be explained as due to changes in the relative pressures in the external and middle ears.

The drum membrane in the mammal, by reason of its shape, its intrinsic elasticity and the thrust factors found in the elasticity of the incudal ligaments, has a tendency to displace lateralward in a position of absolute rest. The decrease in the depth of the umbo which often accompanies the act of swallowing may therefore not be necessarily due to the manner of the tubal closure, as some authorities maintain. The tubal orifice is opened by the contraction of the *M. tensor veli palatini* which, like the *M. tensor tympani*, is found only in mammals. These two muscles arise both phylogenetically and onto-

genetically out of the pterygoid complex and are therefore both innervated directly by motor division of the trigeminal nerve. While a functional interrelation between these two muscles has been hinted at by a number of writers, such a relation has not as yet been experimentally demonstrated. Some individuals seem to have a voluntary control of the *M. tensor tympani* without influencing the tubal orifice in the least (see cases reported by Mangold⁴). If, however, a sufficient degree of negative pressure develops in the middle ear, the *M. tensor veli palatini* may be stimulated to contract and open the *tuba auditiva*. The *M. tensor tympani* may relax at the same time and allow a lateral displacement of the drum membrane without assuming an actual injection of the air through the manner of tubal closure. This lateral displacement probably never attains the proportions observed in forced insufflation of the middle ear cavity. The behavior of the reflex contractions of the *M. tensor tympani* are being studied at this laboratory at the present time.

The problems under consideration in this article may be stated as follows:

First—What is the optimum air pressure in the external auditory canal for acuity of hearing?

Second—What is the quantitative effect on acuity of hearing produced by increases and decreases in the air pressure of the external auditory canal?

In making these tests, a vacuum tube oscillator was used for the generation of electrical currents of the desired frequencies. The harmonics in these currents were eliminated by the use of suitable filters. A thermophone was employed for the transformation of the electrical energy into sound energy. This instrument consists of a thin strip of platinum, about 0.0002 cms. in thickness, mounted in a small case. The variations in the heating of the platinum strip due to the alternations of the current cause corresponding variations in the heating and consequent expansion of the adjacent air. These periodic expansions constitute the sound source. The strip itself has no motion. The thermophone has some advantages over the usual type of telephone receiver in the simplicity of its response characteristic as a function of frequency, in the calculation of its efficiency as a sound source and in the ease

with which the resulting sound may be reduced to minimum audibility. However, a telephone receiver was used in the place of the thermophone in some of the tests.

The thermophone case was provided with two vent holes, one of which led to a water manometer for the control and the measurement of the air pressure, the other vent being connected to an ear tip sealed in the external auditory canal of the observer with cotton and collodion, making an air tight connection. The tests were conducted in an isolated room, the floors and walls of which were lined with felt to eliminate extraneous disturbing noises. The arrangements of the apparatus were such that the observer could not see the water manometer. It was also found on test that he was unable to differentiate between a plus and a minus air pressure in the external auditory canal. Thus a bias in judgment due to knowledge of the type of pressure changes made by the operator was eliminated. Unavoidable fluctuations of attention on the part of the observer were, however, of some slight importance.

Test 1.—With the pressure in the water manometer at normal, certain pitches were exhibited to the point of minimum audibility. When the column of water in the pressure arm of the U-tube was raised and lowered slowly, the following subjective observation was made: In all instances slight increases in pressure "killed" the sound, whereas when the pressure was lowered below normal, the tone was reported as "louder," until the level of about 10 cm. water minus pressure was reached. Further decreases in pressure again "killed" the sound. This was tried repeatedly and with uniform results.

Test 2.—Determinations of the quantitative effect on acuity of hearing due to changes in the air pressure of the external auditory canal were made as follows: The minimum necessary energy (E) for audition having been determined at normal air pressure, this energy was multiplied by a factor of 4, and then the air pressure was varied until the sound became inaudible, both positive and negative pressures being tried. This was repeated with a factor of 16 and in one case with a factor of 64. These tests were made with five different frequencies: 2048, 1024, 512, 256, and 128 p. p. s. In some cases the available range of pressure variation was not sufficient to kill the

sound completely, and in the following table these are noted as "faint."

Frequency	Energy	Plus Pressure	Minus Pressure
2048	4 E	10 cm. inaudible	21 cm. inaudible
	16 E	10 cm. inaudible	27 cm. inaudible
	64 E	20 cm. inaudible	27 cm. faint
1024	4 E	9 cm. inaudible	20 cm. inaudible
	16 E	22 cm. inaudible	26 cm. faint
512	4 E	10 cm. inaudible	19 cm. inaudible
	16 E	22 cm. inaudible	25 cm. faint
256	4 E	8 cm. inaudible	16 cm. inaudible
	16 E	21 cm. inaudible	26 cm. faint
128	4 E	18 cm. inaudible	20 cm. inaudible
	16 E	23 cm. faint	25 cm. faint

Test 3.—In this experiment the minimum necessary energy for audibility was determined for three different values of air pressure in the external auditory canal—i. e., normal air pressure, 10 cm. of water plus pressure, and 10 cm. of water negative pressure. The purpose of this test was to get a quantitative measure of the effect found in Test 1. Several determinations were made at each pressure value, these being taken in random order. Two different tones were used. The average results showed that for a tone of 2048 p. p. s., the necessary energy was 0.33 E when using the negative pressure, and was 1.9 E when using the plus pressure. For the tone of 320 p. p. s., 0.7 E was obtained with negative pressure and 2.5 E with the plus pressure, the E being as above, the minimum energy at normal air pressure. The determinations of minimum audibility were more difficult at the lower frequency than at the higher.

Test 4.—Test 3 was repeated, using a small head type of telephone receiver instead of a thermophone. The receiver was sealed to the external ear with cotton and collodion and provided with a side vent for connection with the water manometer. But one was used, 2048 p. p. s., and it was found that the necessary energy was 0.3 E with the negative pressure and 1.75 E with the positive pressure of 10 cm. of water. The check with Test 3 is good.

DISCUSSION.

It is at once obvious that where we are dealing with sound the influence of the variations in the pressure of the air contained within the apparatus must be considered. The normal pressure may be taken at 76 cm. Hg., or roughly 1030 cm. of water. A change of 10 cm. will therefore only involve a factor of about 1 per cent, which is negligible. A change in pressure also involves a slight change in the volume of the enclosed cavity. However, a decrease in pressure and the consequent small increase in volume both tend to make less effective a given electrical current in the receiver. This, however, operates in the opposite direction to the effect found of an increase in acuity with a small decrease in pressure and consequently cannot serve to explain it. It should also be noted that a pressure change of 10 cm. of water is not very considerable. It is equivalent to raising or lowering an individual suddenly through a distance of about 250 feet. Greater pressures will be studied later, but other problems being considered and the number of ears available at the time was limited to two.

The effect of a positive air pressure in the external auditory canal is to force the drum membrane toward the middle ear cavity. This increases the tension of the drum membrane, but because the direction of the displacement is parallel to the pull of the *M. tensor tympani* the connective tissue which makes up the connection between the drum membrane and the manubrium is somewhat relaxed. Inversely the negative air pressure in the external auditory canal will decrease the tension of the drum membrane and increase the tension in the connective tissue attachments to the malleus. Apparently when air is absorbed from the cavity of the middle ear the drum membrane becomes hypertense, the connective tissue attachments to the malleus are relaxed and the pressure on both sides of the drum membrane is not equal. Perhaps all of these factors tend to interfere with the transmission of sound through the middle ear complex. When therefore the barometer is suddenly lowered by an amount corresponding to 6 or 7 mm. Hg. the pressure on the two sides of the drum membrane appears to be equalized, and the acuity of hearing is consequently enhanced. The average normal individual might not necessarily

experience any increased efficiency in hearing, because the differences are not great and the tubal adjustment may readily compensate for the pressure difference. However, in the cases of individuals with tubal closure even this small pressure variation may have a pronounced effect and the pressure adjustment through the tuba would be wanting, therefore the effect would be more prolonged. Thus it appears that the statement of certain people that they hear better on some days than on others may readily be explained.

There is also a rather common statement which may be considered at this time. It is said that a sound is heard more intensely when the mouth is held open. If the opening of the mouth causes a contraction of the *M. tensor veli palatini* and therefore a readjustment of the pressure of the middle ear, this may also be explained. However, the explanation that the sound pulses pass up the opened tuba and reinforce those striking against the drum membrane from without cannot be considered seriously. For this to occur, the two sets of sound pulses must be in opposite phases. In other words, a rarefaction phase in the one must coincide with a condensation phase in the other. The difference in the distances traveled from the source to the external surface of the drum membrane would have to be an odd number of half wave lengths. If therefore the distance from the source to the external surface of the drum membrane differed from that to the internal surface of the drum membrane by as much as five centimeters then the longest reinforced wave length would be 10 centimeters, and correspondingly the lowest reinforced pitch would be in the neighborhood of 3300 p. p. s. The difference in distance is probably always less than this amount, and therefore only very high pitched notes might be reinforced by an open tuba auditiva.

CONCLUSIONS.

The single case investigated seems to warrant the following statements:

First—The human middle ear under normal conditions is probably under a slight negative pressure.

Second—A negative pressure of 10 cm. of water in the air of the external auditory canal increased the acuity of hearing by a factor of three.

Third—A negative pressure of about 10 cm. of water appears to enhance the transmission of sound through the middle ear in three probable ways: A decrease in the tension of the drum membrane; an increase in the tension of the connective tissue attachment of drum membrane to the malleus; and perhaps a balancing of the air pressure on the two sides of the membrane.

Fourth—The more or less constant negative pressure reading seems to point to the possibility that the tuba auditiva does not open to balance the pressure on the two sides of the membrane as often as is commonly assumed.

Fifth—The variations in the acuity of hearing under these test conditions seems to indicate that steps in the intensity ratio of 5, or even perhaps 10, are sufficiently accurate for all usual purposes in determining the curve of minimum audibility.

Sixth—We submit herewith an accurate method for testing the effects of plus and minus pressures in the air of the external auditory canal which may have a distinct place in the otologic practice. It is our intention to carry on these investigations both with normal and abnormal ears. We hope to elaborate a simple method for gaining more definite information on the functional relation of the drum membrane and the malleus.

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IDIOPATHIC PERFORATION OF THE NASAL SEPTUM. AUTOPLASTY WITH A PEDUNCULATED FLAP OF MUCOUS MEMBRANE. CURE.*

By J. N. ROY, M. D.,

ASSOCIATE PROFESSOR AT THE UNIVERSITY OF MONTREAL.

In this short paper, I desire to draw attention to the treatment of several varieties of perforation of the nasal septum and relate at the same time the history of a patient whom I cured of that affection by means of a pedunculated flap of mucous membrane. It is known that the loss of substance of the septum occurs differently according as it manifests itself as the result of a specific or tubercular lesion (lupus), a cancerous lesion—which, in most cases, ends fatally—as operative lesion, accidental or deliberate, an infected traumatic lesion, a leprous or diphtheric lesion—to mention only the principal microbic diseases susceptible of producing this complaint—or even an idiopathic lesion.

The objective symptoms depend very much upon the size and the cause of the perforation and are especially characterized by occasional epistaxis, by the formation of scabs, and sometimes, when the loss of substance is small, by a nasal hissing sound. To these symptoms there are added from time to time slight pains in the head.

Generally the patients do not seek special treatment for this condition, or, if they do, they content themselves with applying an antiseptic nasal salve so long as they are not inconvenienced by this particular hissing noise. However, it must be admitted that we are powerless if the perforation is considerable, for in that case no autoplasmic method can give any result. Fortunately, however, this kind of perforation never produces any hissing noise.

If, on the contrary, the loss of cartilaginous substance is relatively small, and when the hissing, which is the motive of

*Read before the Congrès français d'oto-rhino-laryngologie, Paris, July, 1922.

the intervention, exists, it is possible to close it by means of a pedunculated flap of the nasal mucous membrane, guided by the following technic:* In the case where the perforation is low enough to make it possible to take a flap appropriated from the upper part of the nostril, it is necessary, after application of a strong solution of cocain and a submucous injection of novocain adrenalin, to make an incision parallel to the nasal bone, varying between two and three centimeters in length. This incision must touch the upper edge of the perforation and terminate near the opening of the nostril. A second rectilinear incision is made, starting from the posterior limit of the first, in a direction anterior to the floor of the nasal fossæ and passing five millimeters from the inferior edge of the loss of the cartilaginous substance. The opening of the nostril is in its turn divided at the junction of the mucous membrane and the skin, and that section, which begins at the anterior part of the nasal floor, terminates on the same plan at the extremity of the vestibule. All the mucous membrane which is behind the perforation is taken away, and that which is in front is detached and turned back in such a way that it will close the opening of the septum. In effecting this maneuver one must be very careful to preserve, at that part of the mucous membrane, an attachment to the edge of the perforation in a manner that will give to it the best nutrition possible. A last incision of about three centimeters is made at the upper limit of the nostril and parallel with the nasal bone, terminating at the vestibule. This pedunculated flap, which must be as large as circumstances will permit, is very carefully detached and lowered in order that the middle part may be opposite the perforation. Its raw surface is then in contact with the anterior piece of reverted mucous membrane, which is also denuded, serving to close the loss of cartilaginous substance, and offering the best conditions of vitality which can possibly be desired. Finally the flap is sutured with silk to the lip of the incision of the opening of the nostril, or coapted by means of small Michel clips. One must always apply a sufficiently firm dressing, for it must not be forgotten that this intervention is made on a mucous membrane which is very susceptible to hemorrhage.

*In the description of this method we are supposing the patient is seated, with head tilted backwards.

However, thanks to the submucous injection of novocain adrenalin, the operation is almost bloodless. If the perforation is found to be placed too high to make closure possible with a flap sufficiently large taken from the nasal bone, it may be taken from the lower part of the nasal fossæ, transposing the method of operation.

It must also not be forgotten that once cut, the flaps of mucous membrane slightly retract.

The dressings must be made in an aseptic manner to hasten the healing of the uncovered part of the septum and to prevent the suppuration which exposes these flaps to mortification.

This method is much simpler than the others, while offering more chances of success. Goldstein dissects first on the two sides, the circumference of the perforation, and next removes a ring of cartilage. To close the loss of substance, he cuts from the immediate neighborhood of the wound a pedunculated flap nearly circular, and slightly larger, taken from the posterior region of the nasal fossæ. Once detached and turned back, the flap is sutured.

Goldsmith and Shurly employ with a technic somewhat different a lamella of cartilage to close the perforation and recover it afterwards with a flap taken from the septum. I should hesitate to employ their method, owing to the danger of infection and its consequences, and also on account of the difficulty of its operative procedure.

Chevalier Jackson prefers to use a piece of the mucous membrane from the lower turbinated bone.

Hazeltine makes an elliptic incision in an anteroposterior direction, circumscribing the loss of substance. After largely detaching the mucous membrane from the upper part of the nostril he makes another incision near the nasal bone, and when the double stemmed flap is lowered he sutures the lower lip to the mucous membrane at the inferior edge of the elliptic section. As with this method the perforation is only two-thirds closed, he repeats the same technic on the other side, taking this time a little narrower flap near the floor of the nasal fossæ which, being elevated, is sutured in its turn.

One of the most arduous phases of these proceedings consists in the application of the sutures, for we all know how difficult it is, by natural ways, to maneuver in the middle part

or even in the anterior third of the nasal fossæ with a needle or the small Michel clips.

With my method, coaptation of the flap is effected quite simply at the opening of the nostril, and all my incisions are rectilinear. Moreover, the phase of the operation which consists in turning back the mucous membrane of the anterior part of the perforation, to close it up, gives more stability to the flap which is applied on a denuded surface and thus increases its vitality—something which is not possible in the other processes. The method which I have described overcomes nasal hissing and the other symptoms, as the following observation shows:

Miss C. M., seventeen years of age, came to see me on February 7, 1922, in regard to an affection of the nose which troubled her very much. She informed me that three years previously she underwent with successful removal of the tonsils and adenoid growths. In March, 1921, she observed a slight tenderness of the nasal septum, which has been gradually increasing. From time to time there were epistaxis and a little cephalalgia, localized more particularly at the root of the nose. Apart from headaches she did not suffer from neuralgia. Since the beginning of her affection there was a slight nasal discharge which later became mucopurulent. When blowing the nose there sometimes appeared small scabs from the left side. In spite of the hypersecretion and the scabs the nostrils were hardly obstructed. The sense of smell was always preserved. With the aid of a mirror, the patient, in April, noticed the presence of a small reddish pimple on the left side of the septum. On the right side the nasal fossa appeared to her as being normal. This growth was accompanied by a little more local reaction, and after having disappeared in the course of the month of May, an ulceration was noticed in the same place. In the first days of July a perforation of the nasal septum appeared. From that moment the inflammatory symptoms, which were never very marked, ceased. No treatment was undertaken during the course of that affection. Although the patient's temperature was not taken, it would seem, according to information furnished, that there had been no fever. The patient acknowledged having always indulged in the habit of inserting her fingers in the nostrils. As soon as

the perforation was established she remarked a hissing noise in her nose when she breathed rather heavily or when she sang. The noise was particularly pronounced during her sleep. As she was mortified by this condition she asked me, with a certain amount of anxiety, if I could cure her.

On making the examination of the nostrils, I observed a small perforation of the nasal septum with its seat in the immediate neighborhood above the vascular area. The perforation, which was round, measured about 5 mm. in diameter. Its contours were perfectly clear, sharp and smooth. On its left side it was surrounded by a zone of very thin cicatricial tissue, a vestige of the old inflammation. The degenerated mucous membrane was symmetrically depressed in a circular manner and much more as one approached the loss of substance. The septum was very slightly deviated to the right, and the turbinated bones were in a normal condition.

On the right side the mucous membrane had undergone no fibrous transformation, and apart from the perforation this nostril was also normal.

The sensibility of the pituitary membrane was preserved. When the patient breathed rather hard a fairly considerable hissing was heard. The exterior of the nose was rectilinear.

There was nothing interesting to note in the pharynx and the cavum.

The lacrimal ducts were normal and the patient never had epiphora.

Brought up in the country, she has rather a robust constitution, and presents no symptoms of syphilis or tuberculosis.

Moreover, the whole of her family is in excellent health, and there is no disposition to rheumatism or nervousness.

In presence of this idiopathic perforation dating back for seven months, I proposed, in order to get rid of the nasal noise, to close the opening of the septum by means of a pedunculated flap of mucous membrane. This intervention being accepted, it was postponed until February 10, and in the meantime the patient returned home with a boric menthol salve for her nose.

Operation.—Though the left nostril was somewhat larger than the right and afforded more facility for my operative maneuvers, I nevertheless decided to intervene on the other

side, because of the zone of cicatricial tissue adjacent to the perforation. As a matter of fact, the ill nourished fibrous tissue would have exposed the flap to mortification or, having removed it, I might have had a piece of mucous membrane too narrow to close the cavity properly. So after having applied a solution of cocain, I made a submucous injection of novocain adrenalin in the right nasal fossa. After an interval of several minutes I made an incision parallel to the nasal bone about 25 mm. in length, touching on its course the upper limit of the perforation and terminating near the opening of the nostril. I then made another rectilinear incision which commenced at the posterior termination of the first and which, extending to the anterior part of the floor of the nasal fossæ, passed 5 mm. underneath the lower edge of the perforation. From there the mucous membrane at the summit of the triangle was totally removed. The opening of the nostril was in its turn incised near the union of the mucous membrane and the skin, and the incision continued up to the upper extremity of the vestibule. The mucous membrane was detached with very great care, as far as the neighborhood of the anterior limit of the perforation, and then turned back in a manner to close the loss of substance of the septum. Finally a last incision, 3 cm. in length, was made as high as possible and parallel with the nasal bone. This flap, which was about a centimeter wide, possessed a good pedicle and, once detached and lowered, it amply covered the part of the perforation already filled up. After having fully verified its position, I sutured it with silk to the edge of the incision made at the opening of the nostril. Although the hemorrhage was very slight, I nevertheless applied a firm dressing. This dressing was renewed at the end of forty-eight hours, and every day afterwards during the first week. The sutures were taken away eight days after the operation, and healing continued normally. The flap adhered well to the place where it was applied and covered entirely the perforation. The patient was sufficiently cured to be able to return home twelve days after the intervention. She took with her mentholated oil to continue sterilization of the nasal fossæ. At that moment, the mucous membrane, which I had turned back to fill the opening of the septum, was hardly perceptible to an anterior rhinoscopy of the left nostril.

-I saw my patient from time to time, and at the beginning of May she was perfectly cured. The flap, which exceeds the limits of the perforation, is very solid. The rest of the septum is thoroughly healed, and there is no more secretion in the nose. Respiration is excellent on both sides. The nasal hissing has naturally stopped, as well as all other symptoms of which the patient complained.*

The case which I have just related proves once more to what point a simple lesion caused by a scratch can have serious consequences. Indeed, this young girl, who had a habit of inserting her fingers into her nose, one day produced with one of the finger nails an injury on the left side of the septum. A little submucous hemorrhage occurred, which was soon followed by infection, and there resulted a perforated idiopathic ulcer well described by Hajek. Happily for the girl, the loss of substance was very small, and a cure took place even without treatment. Immediately after cicatrization the scabs and epistaxis definitely ceased, and of the inflammation there remained only the nasal hissing.

According to the anterior rhinoscopy, the phenomenon can be explained in the following manner: As there had been a slight deviation of the septum to the right, and as on the left side the perforation was surrounded by a very sharp fibrous tissue, the amount of air on that side was greater on respiration than on the other, causing a suction, so that the air of the right nostril, passing through the opening of the septum, made the hissing noise. I further believe that the cicatricial tissue also played a certain part in the production of the hissing.

716 ST. HUBERT STREET.

*This patient was presented at the Montreal Medical Society in March, 1922.

XLVI.

OTITIS MEDIA, MASTOIDITIS AND DISEASE OF
NASAL ACCESSORY SINUSES AS CAUSATIVE
FACTOR IN MALNUTRITION IN
CHILDREN.*

By T. H. ODENEAL, M. D.,

OPHTHALMOLOGIST AND OTOLARYNGOLOGIST TO THE BEVERLY
HOSPITAL AND MASSACHUSETTS STATE INFIRMARY,

BEVERLY, MASS.

This report comprises the colored races only, malnutrition among the Caucasians being a rarity on the Canal Zone, where these cases were collected.

In looking up the subject of malnutrition in the textbooks on children's diseases I was enabled to find only twice mention made of the connection of the ears and malnutrition, its connection with acute otitis media only being mentioned and that in a few lines.

Of the cases of malnutrition admitted to the Ancon Hospital, Panama Canal, approximately 75 per cent had ear disease at some time during the course of the disease. These cases were admitted as a rule late in the disease, and many were hopeless at the start. A few cases came in with suppurating ears and noses, but the majority gave a negative history as to sinus or ear disease.

These little patients were sent to the eye and ear clinic as a matter of routine. A few presented the characteristic acute otitis media with relief of the high temperature and improved general condition on puncture of the drum, but the majority had to all appearances perfectly normal ear drums with the exception of a lack of luster and slight thickening, which did not prevent the light reflex.

After paracentesis of these apparently normal ear drums an improvement in the patient's general condition took place not-

*Read before the Canal Zone Medical Society, January, 1922.

withstanding the fact that the ears would not discharge for two or three days after paracentesis as a rule. The ears discharged a few days and stopped only to fill up again and rupture at intervals.

It was thought that cauterizing the lips of the wound in the drum would give more permanent drainage, and this was done with pure trichloroacetic acid, resulting in a permanent opening but without any lasting benefit to the patient, proving conclusively that not the ears but the mastoids were the foci of infection.

This delayed discharge from the ears after puncture I attributed at first to infection from the canal of the ear, but from my findings at operation on the mastoids in these cases and their behavior after operation I am now convinced the late discharge is due to slow drainage from the mastoid cavity.

The infected ears which have not been punctured drain through the eustachian tubes, the mastoid cavities filling up with pus and discharging into the ears and thus through the eustachian tubes by aspiration through negative pressure in the nasopharynx created in the act of crying, coughing, etc.

This cycle of the mastoid cavity (the mastoid at this age is chiefly antrum), filling up and discharging periodically through the eustachian tube, is repeated again and again until resolution or death occurs.

At autopsy Dr. Clark, our pathologist, found that approximately 80 per cent of the malnutrition cases were affected with mastoid disease.

Of course the question is asked whether this mastoid involvement is not a secondary condition, and this is a very vital question indeed, for on its answer hangs the lives of hundreds of infants. Before convincing myself, I was just as sure it was a secondary process due to the lowered resistance of the patient, incident to the malnutrition, as I am now of its primary origin.

Every one of these patients in which mastoid operation is called for die, without any exception, and, taking this into consideration, together with the high percentage of mastoid involvement at autopsy and the fact that although temporary improvement is obtained by paracentesis no permanent

benefit results, the probability of there being a primary focus of the malnutrition in the mastoid was to my mind excellent.

Mastoidectomy therefore was decided on all cases with ear disease that continued to decline. In all, seven cases were operated with four deaths, three of which were hopeless at the time of operation, the power of resistance being too low to permit recuperation.

The three that recovered were not expected to live before operation, and their recovery I lay to the fact that their illness was of shorter duration and their resistive power had not been undermined to such an extent that they could not come back.

The operations were performed under chloroform anesthesia and lasted from fifteen to twenty minutes, the patients showing no signs of shock.

A simple mastoidectomy was performed on the first few cases, but granulations formed so quickly and were so numerous, occasioning bleeding at each dressing, disastrous to the patient, that a modified radical was done on the later cases and found to be much more preferable. Adrenalin was injected in the perimastoideal tissues previous to operation to prevent loss of blood. After one week no dressings were required and simple irrigation sufficed until healed.

As 75 per cent of our cases had clinical ear disturbance and at autopsy 80 per cent mastoid involvement, it is readily understood what an important part the ear plays in this sad disease.

The vegetative nervous system is so easily deranged in children that the slightest irritation will cause disturbance of the metabolic function. This we see particularly while they are cutting their teeth, a rash perhaps appearing on the body, the glands becoming enlarged and vomiting of meals even occurring with rise in temperature at times.

If the teeth will cause all this disturbance while erupting, is it any wonder then the ears will do the same when attacked by an infectious process?

It is very often difficult to discover that the ears are at fault, as an abscess will form in the ears without occasioning any rise in temperature. For this reason a fresh disturbance in the patient's condition (vomiting of feedings, diarrhea, etc.) will be charged to the milk or anything but the ears, as the

attending physician naturally expects a rise in temperature when the ear becomes involved.

This is the real reason why the ears escape detection and are not looked on as vitally important to the treatment of malnutrition cases. The ear or ears will become infected, an abscess forms and discharges through the eustachian tube or drum without occasioning any rise in temperature. If the ear discharge through the drum it is detected; if through the eustachian tube it is not detected, and if the mastoid cavity becomes involved the patient slowly but surely declines.

Every case should be operated upon that continues to decline where there is a discharge from the ear or ears, everything else being negative of course.

Failure is very rapid, and just as soon as it is determined that change in diet is not beneficial operation should be done without delay.

Our pathologist, who makes it a custom to open the ears and sinuses in all autopsies, reports 50 per cent of the malnutrition cases as having maxillary sinus suppuration, often under tension. This fact alone is very important, as it affects the progress of the disease and might prevent recovery when other causes are removed.

The only solution to this I can see is to puncture every antrum in the cases that continue to decline and where pus is encountered put in a metal drainage tube, irrigating the antrum until the discharge ceases. If the antrum is irrigated by means of a canula much blood is lost at each irrigation, as the little patients bleed easily and freely, more harm than good is done, as every drop of blood is precious to them in their debilitated state.

In the patients old enough to have ethmoids these are affected quite often, but the cells are very small and will care for themselves if other causes are removed.

The findings at autopsy are based on several hundred cases from birth to three years of age.

Although skeptical at first as to the primary nature of the mastoid involvement, this series of cases operated upon, small in number, has yet convinced me that it is primary and that

many deaths are charged up to malnutrition which in reality should be laid to the mastoids and ears.

As explained before, we received our cases late in the disease, which consequently gave a high mortality rate.

Even if the history could be relied on, the greater majority of these cases could be saved, and if the patients were received into the hospital early in the course of the disease all could be saved that have mastoid involvement.

Irrigation of the maxillary sinuses in every case operated upon for mastoid disease is recommended to determine if they are affected, and, if so, treatment as recommended instituted.

CASES.

In all, ten cases are reported, seven of which were operative.

The blood, urine and feces were negative; von Pirquet positive in one.

All those operated upon were marked cases of malnutrition, with vomiting of feedings, diarrhea, slight or no temperature, and loss of weight.

Case 1 was of an infant of four months, which vomited all feedings, had severe diarrhea and was rapidly losing weight. Both drums of ears normal on admission. After a few days in the hospital the patient began to pick up and gain in weight, with finally cessation of vomiting and diarrhea.

Three weeks after admission the patient began to vomit and have diarrhea again, which continued to increase, with loss of weight until the patient was in a serious condition. Eleven days afterwards the right ear began to discharge and the patient improved, vomiting and diarrhea ceased and the patient was discharged well with a gain of two pounds over the weight at admission.

The gain in weight with disappearance of the other symptoms shortly after admission was without doubt due to proper food. The setback with vomiting and diarrhea was due to a suppurative process in the ear which on evacuation relieved these symptoms almost immediately. No rise in temperature registered the ear condition, and it was overlooked, as the ears were reported normal several times on previous examinations. This formation of abscess of the middle ear, with or without

rupture of the drum, without any effect on the temperature, is very frequent, and is the chief reason why the ear is not suspected in malnutrition cases. If this ear had discharged through the eustachian tube instead of the drum, the cause of the setback would have been laid to the feedings. Perhaps the cause of some of these ears discharging through the drum while others discharge through the eustachian tube is that the eustachian tube becomes blocked by inflammation of the nasopharynx (nasopharyngitis, swollen adenoids, etc.), causing the secretions to distend the middle ear and rupture the drum in place of discharging through the tube. This case is cited as one of many to show the importance of frequent ear examinations in malnutrition.

Case 2.—An infant of one year and five months, with marked symptoms of malnutrition. Gave history of right ear discharging for two weeks.

The patient could not retain feedings and had profuse diarrhea, with loss in weight. On admission right ear was discharging; the left ear normal, which was punctured and cauterized nevertheless with escape of a little thick mucus.

Both ears discharged next day and continued to discharge, the vomiting and diarrhea becoming worse and the patient lost weight rapidly.

Two weeks after admission a double mastoidectomy was performed, under chloroform anesthesia lasting thirty minutes. Both mastoids were filled with pus; culture from the right gave nonhemolytic streptococcus; from the left, *B. pyocyaneus*. Improvement after operation was remarkable, all vomiting and diarrhea ceasing, with a gain of one pound and four ounces in weight in eleven days. Sixteen days after operation vomiting and diarrhea began again. This continued with loss of weight up to time of death, one month and three days after operation.

At autopsy no lesions were found outside of the ears and mastoids.

Operation certainly improved this case and the patient would have lived if, to my mind, the drainage from the mastoids could have been kept free; but the granulations were so exuberant and formed so quickly, requiring constant attention, that the drainage was interfered with, causing constant ab-

sorption. A modified radical operation, which was done on the later cases, would, I believe, have saved the patient if done in the first place. The mode of onset of the illness indicated the ears were the primary source of the trouble.

Case 3.—Aged one year, admitted on the seriously ill list, in very undernourished condition, vomiting all feedings, and diarrhea.

Right ear on admission discharged a bloody serum; left drum appeared normal, but was freely incised. Both ears discharged and condition grew worse until, five days after admission, a double mastoidectomy was performed under chloroform, lasting fifteen minutes, although medical service advised against it, as the infant was certain to die, whether operated upon or not. Cultures from mastoids gave streptococcus irridans, staphylococcus albus and *B. pyocyaneus*.

Patient died next day after operation. At autopsy the ears, mastoids and maxillary sinuses contained pus, under tension in the sinuses; bronchitis and atelectasis, acute parenchymatous degeneration of the kidneys, heart and lungs.

Cause of death: Malnutrition with suppurative otitis media, mastoiditis and sinusitis as contributory causes.

Case 4.—Aged one year and two months, admitted with marked symptoms of malnutrition, very much wasted condition, vomiting of all feedings, diarrhea. History of discharging ears of one week's duration. Continued to decline and was placed on seriously ill list.

Thirteen days after admission a double mastoidectomy was performed, lasting twenty minutes, under chloroform. Pus was found in both mastoids; cultures positive for streptococcus hemolyticus. The patient did not improve after operation and died two weeks afterwards. At autopsy no lesions were found outside of ears and mastoids.

This case was undoubtedly due to early mastoid involvement, and the history was of little value, the infant no doubt having contracted the ear trouble sooner than the time given by the parents.

The prostration was too severe at the time of entrance to the hospital for the illness to have been of such short duration.

No bacteremia was present; the infant's resistive power was lowered too much to have been benefited by operation.

Case 5.—An infant of four months, admitted in a very much emaciated condition, vomiting of all feedings, and severe diarrhea. Right ear discharging at time of admission. Left began in a few days. Condition pointed to ears as cause of disturbance and operation advised but refused by parents.

Death several days after removal from hospital. Time in hospital, twelve days.

At autopsy the mastoids and middle ears were filled with pus containing *B. coli*. Maxillary sinus full of pus under tension.

This is another case which entered the hospital too late to carry out observation as to the cause of the condition and the benefit derived from proper feeding. By the time it is determined that the feeding is of no assistance in these cases it is too late to save them through operative means. If these cases were brought in at the beginning of the illness there would be sufficient time to trace the cause and to remedy the condition, but the parents are so ignorant and neglectful in this class of cases that they will allow the infant practically to die before entering the hospital. In this case the infection in the antrum would probably have prevented recovery alone unless irrigated.

Case 6.—Aged one year, admitted in very bad condition, with marked symptoms of malnutrition and both ears discharging profusely. Failed rapidly, developing eczema of head and ears, became listless and apathetic, dying three weeks after admission.

At autopsy the ears and mastoids contained pus in abundance, as also did the maxillary sinuses; no other findings.

Probably this infant could have been saved if the history could have been relied on and the case operated upon as soon as admitted. If this had been a white child of intelligent parentage the history could have been relied on and mastoidectomy would no doubt have been performed at once.

This is a case of low grade mastoiditis causing disturbance of the gastrointestinal tract, with finally malnutrition, and it is cited along with Case 5 to impress the fact that the so-called

malnutrition cases are ear cases primarily, the malnutrition being secondary to the ear infection.

Case 7.—Aged one year and one month, placed on seriously ill list on admission. Both drums normal on admission, later the right discharged after paracentesis. The patient continued to decline and bilateral mastoidectomy was decided on and performed five days after admission. At operation both mastoids appeared normal. Patient died nine days after operation.

At autopsy the mastoids were found in normal state; the left maxillary sinus contained pus under tension.

This little patient was very anemic, the red cell count was only two million and the resistive power was not sufficient to allow recuperation after proper food was obtained.

This case was the only one where the mastoids were found uninvolved. It was a case of anemia and not a true case of malnutrition.

Case 8.—An infant of nine months, was quite ill on admission, vomited all feedings, severe diarrhea, both ears discharging. Due to rapid decline, double mastoidectomy was decided on and performed nine days after admission. Patient made rapid recovery, vomiting and diarrhea discontinued and gained markedly in weight. Was discharged well.

This infant would certainly have died without operation and surprised everyone when it recovered.

Case 9.—Aged one month, admitted with all the symptoms of malnutrition, vomiting of feedings, watery diarrhea, etc., and was losing weight rapidly. No history of ear trouble. Began to improve until one month after admission all the symptoms returned and it began to fail fast. Both ears were punctured several times with marked improvement in the symptoms, there occurring a gain in weight with cessation of vomiting and diarrhea after each puncture, but without any lasting benefit.

The patient's condition was such that it was finally placed on the seriously ill list and mastoid operation advised.

A double mastoidectomy was performed two months after admission, when it was found that both mastoids contained pus.

Recovery was remarkable; all vomiting and diarrhea ceased in a few days after operation and patient was discharged one month after operation with a gain of two pounds and thirteen ounces.

Although no history of ear involvement was obtained it is practically certain such existed. The drums were normal in appearance, but there was decided improvement in the patient after each paracentesis. This was clear evidence that the pus was in the ears and discharged through the eustachian tubes, the contained pus acting as a focus of infection and causing the irritative gastronomic symptoms.

On removal of the focus of infection prompt recovery took place.

Case 10.—An infant of eight months, admitted with marked symptoms of malnutrition and in a very much emaciated condition. No history of ear involvement. For almost a month first one ear and then the other would discharge, with temporary improvement each time, but the patient gradually declining until placed on the seriously ill list.

One month after admission a double mastoidectomy was performed, both mastoids found containing pus. Two days after operation improvement in symptoms became manifest, and eight days after operation all vomiting and diarrhea had ceased. At time of this report was gaining weight rapidly and pronounced well.

XLVII.

RELATIONS BETWEEN THE EYE AND EAR (INCLUDING THE VESTIBULAR ORGAN).

BY PROF. J. VAN DER HOEVE,
LEIDEN, HOLLAND.

As I am to speak to otolaryngologists as well as to ophthalmologists, I sought a subject in those parts of medical science which divides as well as unites the branches which we practice.

In doing so, the first thing that appeals to us is the relation between nose and accessory sinuses to the eye, because these cavities are so close to the orbit and optic nerve. The ear is so great a distance from the eye that it seems nearly impossible that direct influence is exercised from one organ on the other, and yet I for one believe that the relations between eye and ear, at least when we include the vestibular organ, are of much greater importance to mankind than those between nose and eye.

We may divide my subject into four parts:

1. Diseases and intoxications which cause eye and ear symptoms.
2. Eye diseases, which cause ear symptoms.
3. Ear affections, which cause eye symptoms.
4. Relations between the vestibular organ and the eye.

I will pass over the three former quickly so as to spend the greater amount of my time on the last and most important one.

We all know, that there are a great many diseases and intoxications which cause eye and ear symptoms. Of the latter we can for instance mention intoxications with chinin, optochin, salicyl, wood alcohol, etc.; of the former the well known ones as syphilis, especially the hereditary form, tuberculosis, scrophulosis, etc. I wish to ask your attention to some of the less well known and yet important diseases. In the first place, to the syndrome of blue sclerotics.

It is known that in 1910 Eddowes taught us in a very short publication the existence of a hereditary disease, in

which the sclera had a grey-blue or slate-blue color, in which the patient suffers from brittle bones; in other words, fractures of different bones occur on the slightest provocation, such as putting on an overcoat, falling on a feather bed, etc.

Eddowes thought that this was due to a lack of fibrous tissue.

Eddowes' communication was forgotten and later on the facts rediscovered, many authors having reported histories of a great many cases of this interesting disease without developing any new facts, until about four years ago Dr. De Kleyn of Utrecht and I found that these patients became deaf as they grew older.

About the same time this was also noted by an American named Bronson, who was then in Edinburgh.

I am convinced that the sufferers of blue sclerotics are nearly always subject to brittle bones and ear affection, but in the records you will find that every afflicted being has blue sclerotics; many, brittle bones and some only deafness.

This may be caused by the fact that when the blue sclerotics are present it is observed immediately; brittle bones may pass unobserved when no traumatisms occur to the patients and otosclerotics do not become aware of their trouble till later in life.

The cause is a maldevelopment of the mesoderm.

There are other infirmities, which may occur in those patients as arcus corneae juvenilis, sprains, weak ligaments, etc.

The patients often are small, crooked persons; the girl whose picture I show here, had about 27 fractures of different bones—e. g., of the spinal column, pelvis, legs, skull, etc. The most interesting feature is the affection of the auditory organ. Until a few years ago it was thought, that the inner ear could not be photographed with Roentgen rays in such a way that the photographs could be used for clinical purposes, but Dr. Stenvers of Utrecht taught us otherwise. You see here in a skull the inner ear made more visible by filling it with lead, the cochlea, the semicircular canals, the cavum tympani and the meatus auditivus internus are clearly visible.

The next lantern slide shows the same in a normal living person presenting the inner ear in a case of otosclerosis in

a patient with blue sclerotics; the inner ear is seen, a black mass, in which we can only find a few remains of the labyrinth.

As in those rare cases the relation of eye and ear is of some value, it is necessary when a patient comes to us with blue sclerotics to advise him not to enter a profession in which he is exposed to traumatism on account of the brittle bones, and to warn him that his hearing may get worse when he grows older. Professions in which acute hearing is a first duty, as telegraph or telephone operator, Marconi operator, etc., should not be chosen.

In the second place I wish to mention the eye affections, which often are found in congenital deaf and dumb people: as pigmental degeneration of retina, either in the form of the well known retinitis pigmentosa or in other forms.

It may be of some interest on this account, that in making ophthalmoscopic examination in the congenital deaf and dumb animal race, such as the Japanese or Chinese dancing mice, I found in every specimen examined a pigment-degeneration of the retina, sometimes in a form very much like a retinitis pigmentosa, but at other times more like degeneration after a chorioretinitis.

Though this fact is very easily ascertained by ophthalmoscope, histologic investigation is not so easy, but I hope we shall also be able to prove this fact anatomically. In any event both facts show a very intimate connection between retina pigment and deafness.

I wish to consider still a third instance of disease with eye and ear symptoms.

We know a peculiar disease under the name of tuberose sclerosis of the brain, in which as a rule idiotic epileptic young people have tumors and cysts in the brain, in the heart, the kidneys, the thyroid gland and in the skin. I have now observed in this disease tumors of the optic nerve disc and of the retina until now unknown.

There is another nerve disease, which we know under the name of the Recklinghausen disease, in which there are multiple neurofibromata in the skin and at the peripheral nerves and in the acoustic nerve.

Some neurologists, as Bielschowsky, etc., think that both

diseases are one and the same, only with different localization of the tumors, and consequently they speak about spongio-blastosis centralis, peripherica and universalis.

Nieuwenhuysen, on the contrary, is convinced that those diseases are two entirely different, well defined affections not to be associated. A couple of months ago I examined in the clinic of Prof. Winkler in Utrecht a patient, who was deaf, feeble sighted and had atrophy of many muscles. Diagnosis was made of meningitis with consequent deafness and muscle atrophy, but when Dr. Stenvers made X-ray photos of the inner ear to find out what was amiss, he discovered on both sides a considerable enlargement of the porus acusticus internus, which as you can see on these skiagrams did enlarge still more after a lapse of time.

So it seemed highly probable that the deafness was caused by a tumor of the acoustic nerve; the patient was reexamined and they found some neurofibromata on his back. The diagnosis was therefore changed to Recklinghausen's disease.

The vision of the right eye of this man had been reduced for many years caused by a retinal detachment. We find in the retina a huge mass, which looks like the remains of a Coates disease but it may be a tumor mass. There is a tumescence at the optic disc, which possibly may be a tumor of the disc. However, this eye is too much altered to permit a reliable diagnosis. The other eye shows a choked disc (5 diopters), and there are also in the retina two small tumors ophthalmoscopically just like the tumors in the cases of tuberose sclerosis of the brain.

Though the real proof can only be established by histologic examination of the eye, I am thoroughly convinced that this man has the same kind of retina tumors as patients with tuberose sclerosis show.

If this proves to be true, it is highly probable that the disease of Recklinghausen and the tuberose sclerosis are diseases at least very closely related to each other, since it would be almost inconceivable for such rare tumors to develop in different diseases. So you see how important again the eye and ear symptoms are. Ear therapy enabled me to make the diagnosis of the Recklinghausen disease and eye pathology may perhaps help to solve this neurologic puzzle.

2. As to eye diseases causing ear conditions I know only of one; the sympathetic ophthalmia, which is said to be the cause of deafness.

The first who observed this fact, Snellen, a. o., thought the deafness to be caused by a meningitis spreading from the optic nerve sheaths, because they believed in Deutschman's theory of the migration of the sympathetic ophthalmia along the optic nerve sheaths.

Nowadays this theory has become more or less obsolete and other theories are more favored.

Peters, who believes that deafness is not a very rare occurrence in sympathetic ophthalmia, explains the deafness by one of the modern theories and he chooses Elschnig's theory, which holds that the sympathetic ophthalmia is an anaphylactic process in sequence of sensibilization from pigment caused by the inflammation in the first eye. Now it is possible that just as the pigment in the second eye, also the pigment in the labyrinth becomes sensibilized and causes the ear disease. The individual difference in the amount of labyrinthine pigment can explain why deafness occurs in one and not in another.

I for one cannot say that I have often found deafness in sympathetic ophthalmia, but this theory shows again how close relation is thought to be present between eye and ear pigment, and I am thoroughly convinced that this relation is a very important one. We often encounter deafness in albinotic animals, for instance, white cats. As a rule these cats have a blue iris, which means that they are not absolutely albinotic, whereas total albinotic cats are not deaf. The same is true of white mice; totally albinotic white mice are not deaf, while the partial albinotic dancing mouse is deaf.

Concerning the relations between eye pigmentation and deafness there are several possibilities.

1. The pigment aberration causes the deafness.
2. The ear disease causes the pigment aberration.
3. Both are independent of each other and may come from the same origin.

The first is perhaps the case in sympathetic ophthalmia. As to the second possibility, Peters suggests, that the eye pigment may be sensitized from the labyrinth to a spontan-

eous bilateral irridocyclitis; this supposition lacks evidence up to the present.

Von Stein thought that the relation between eye pigment and labyrinth is so close a one that whenever he destroyed one labyrinth in a guinea pig he observed pigment changes in both eyes. Von Steyn could cause pigmentation as well as depigmentation of the eye by destruction of the cochlea, and supposed that there was in the cochlea a trophical center for the eye.

I cannot believe the relation between ear and eye pigment to be so close and simple, because Dr. De Kleyn and I did not observe a change in eye pigmentation in a great number of guinea pigs, rabbits and cats in which one labyrinth was destroyed for other reasons, either immediately nor some weeks or months after the operation. We had the same negative results in observing human beings, where the labyrinth was destroyed by diseases, so that we came to the conclusion, that pigmentation changes in the retina are often found in congenital but seldom in the acquired labyrinth deafness, and that it has not yet been proved that pigment changes are dependent upon the ear disease.

3. We have come to the third part of our subject, the influence of the ear on the eye. I will not discuss choked disc due to acoustic tumor or otogenic encephalitis or meningitis, but I will refer to some other diseases: In the first place thrombosis of the sinus cavernosus. Every ophthalmologist should always bear in mind that this usually fatal disease may have its origin in an otitis so that as soon as we can make the diagnosis or even suspect it, we ought to consult with an otologist, because, as I know from experience, operation upon the ear may sometimes prevent fatal issue.

Another eye symptom caused by an ear disease which occurs more frequently is the paralysis of the abducens nerve in otitis media. Some time ago I saw a most striking instance. A village physician sent a boy with paralysis of the right sixth nerve and stated that he had observed purulent secretion out of the right ear. When the boy came to Leiden the purulent secretion had stopped entirely and the otologists could not find the least symptom of otitis media, not even a scar or perforation in the tympanic membrane. The

boy was taken in my ward. Two days later the purulent secretion reappeared and the paresis improved, and a very small perforation was observed in the tympanic membrane. The secretion stopped again, the paresis became worse; this repeated sometimes.

What is the relation between the paralysis and the otitis? Gradenigo thinks that there is a meningitis at the top of the os petrosum; others consider it a pressure due to inflammatory edema and venous stasis in the narrow slit of Dorello, where the nervus abducens passes with the sinus petrosus superficialis. I for one believe that toxins play a part also by being distributed by spreading in the neighborhood, so that as soon as the free exit of the pus was blocked, the paresis was increased by toxic edema. It is like the affection of the optic nerve in disease of the accessory sinuses and like eye affections of dental origin.

According to my conviction, it is somewhat absurd to suppose that the toxins are absorbed by the fluids and run around the body to come exactly to the spot of origin next to the heart to exercise their pernicious influence.

It is much more probable and quite in accordance with the fact that the least obstruction causes immediate exacerbation to consider that the toxic influence comes directly from the toxins spreading in the neighborhood.

The combination of ear disease and abducens palsy may also be found in cases of traumatism. I present the roentgenogram of a man who, following a trauma of the head, became deaf and had an abducens paralysis. A fracture in the os petrosum passing through the cochlea is to be observed.

If we will remember that we have an otogenic pupillar and a palpebral reflex, we will discover in daily practice manifold relations between the eye and ear worthy of our cordial interest and valuable to our patients and ourselves.

Much more important than those direct clinical relations of the ear and eye are those between eye and vestibular organ, many of which have already found a place in the routine of our daily practice. They are not only of clinical interest, but also of high scientific significance, both from a physiologic as well as pathologic point of view.

THE VESTIBULAR ORGAN AND THE EYE.

The inner ear is composed of two different parts, which, though both are innervated by branches of the acoustic nerve, do not concern each other; the real auditory organ, the cochlea innervated by the *nervus cochlearis* and the vestibular organ innervated by the *nervus vestibularis*. Formerly the vestibular organ was thought to be a part of the auditory mechanism, and many names still recall this error to us. Since the classic experiments of Flourens, however, we know, that the vestibulae is a part of the organ of equilibrium and it is only the very close and intimate anatomic relation which gave this precious treasure to the otologists, although it has become the center of study and tremendous mutual interest for physiologists, neurologists and ophthalmologists as well as of otologists.

The vestibular organ consists of the three semicircular canals and the two spaces which we call the utricle and the saccule. In the ampullae of the semicircular canals we find the *cristae acusticae*, that are the nervous endings of the *nervus vestibularis* in nerve cells with motile hairs, moving with the motions of the lymph in which they are floating. Every movement of this fluid acts as an excitation to the nerve cells, so that those canals are the most excellent apparatus to perceive every motion of the head.

In the saccule and utricle we find the *maculae acusticae*, nerve cells on which rests a membrane with calciferous impregnation, the so-called otolith membrane, which in some animals, as fishes, is so developed that we can speak of a real stone, the otolith.

Otoliths may exercise influence on the *maculae* by pressing on the nerve cells or by pulling at them, consequently the stimulation which they cause will be altered by every change in position of the otolith organ, and thus the otoliths are an excellent organ to perceive every different position of the head in space. Numerous theories are brought forward and experiments performed to explain the function of the vestibular organ and I need only mention the names of Flourens, Mach, Breuer, Ewald, Kreidl, Kubo and Barany. You know how Barany applied our knowledge of the function of the vestibular organ for use in daily practice.

I think that some of the very best work done in this connection in the last ten years was in the pharmacologic laboratory in Utrecht by Magnus and De Kleyn and their co-workers. This is so important, that Barany himself is always in correspondence with these Utrecht men to hear whether his hypotheses are confirmed by the interesting experiments undertaken at that place.

The experiments were made on animals, frogs, cats, dogs, guinea pigs, but especially on rabbits, with the purpose of getting an exact knowledge of the function of the vestibular organ in those animals and thus to approach the problem in human beings, where the conditions are so quite otherwise.

The first thing which was necessary, was to be exactly acquainted with the anatomy of the vestibular organ of the rabbit.

In the anatomic institute in Utrecht de Burlet made serial slides of rabbit skulls, reconstructions in wax of skulls and membranous labyrinth; on the slides was made a mathematical drawing reconstruction, which was controlled by Prof. Ornstein with an analyticogeometrical formal system. In this way they succeeded in getting exact knowledge as to the anatomy of the labyrinth of the rabbit.

According to the result of this examination a magnified model of the labyrinth was constructed. It was too large to bring it with me but I can show you here a model of the otolith apparatus only, which represents their real position in the rabbit skull. The maculae acusticae are represented by these colored plates, the otoliths by these leaden ones. You see that in giving the rabbit skull different positions in space we can see what the position of the otolith is under any position of the skull. We know that the labyrinth may cause clonic and tonic reflexes on the eye muscles so that nystagmus is produced by the clonic reflex, whereas the position of the eye in the orbit is determined by the tonic. Now Magnus and De Kleyn found that the labyrinth produces also tonic reflexes on the body muscles and they tried to determine which reflexes were produced by the different parts of the vestibular organ.

They found that the vestibular organ causes maximal tonic contraction of the extensors of the limbs when the head of

the rabbit was placed topsy turvy, minimal when the head had its normal position with the mouth fissure horizontal.

This reflex was ascribed with high probability to the utriculus otolith so that we see the otolith causes the maximal extension of the limbs when it is dragging at the macula, no extension when it is pressing on the macula. The same otolith causes also extension of the neck muscles with, of course, the same maximum and minimum positions, but there is an important difference between both reflexes.

The utriculus otoliths are in contact with the limbs of both sides, so that when one labyrinth is destroyed the reflex rests the same in quality.

Concerning the neck muscles, on the contrary, the otolith is only in relation to the muscles on one side, so that when one labyrinth is destroyed the reflex causes bending of the neck.

A third labyrinth reflex results in the animal trying to bring back his head to the symmetrical medial position as soon as it has left this position. Magnus calls these reflexes stell reflexes.

They are probably caused by the main part of the sacculus otolith. Every sacculus otolith awakens a reflex, which tends to press the head in a direction opposite to the otolith. So long as the head is in the symmetrical medial position the influence of both otoliths counterbalance each other, but as soon as the head is bent to one side the otolith of that side is dragging more and thus stimulating more; the other is dragging less and thus stimulating less, so that the lowest otolith has the most influence and presses the head back again into the symmetrical position, which he cannot pass, for in that case the influence of the other is gaining in strength while the first loses its influence. If one labyrinth is destroyed the influence of the remaining sacculus otolith is no more counterbalanced, and it will press the head to the other side, until the head is in a horizontal position with the side of the remaining labyrinth above. Then the sacculus otolith presses on its macula, drags no more, so that this is the rest position, as was already determined by Flourens' experiments.

These reflexes have more than theoretical importance, for we can find them under circumstances in human beings, and they may be used for diagnosis. These reflexes are very dif-

ficult to discover in animals, and almost impossible in human beings, for the reason that they are obscured by voluntary movements and by other consequences of brain action.

They are found in animals the best when they are decerebrated. In human beings we find them when the brain does not yet act properly, as in some children under three and one-half months old, or when the brain is partly diseased. Magnus and De Kleyn have studied the course of the reflex, and thus we may conclude when the reflexes are present which part of the brain is still acting. These reflexes were found in patients with idiocy, meningitis, hydrocephalus, apoplexy and diabetic coma.

As a rule it is an ominous sign in brain disease when these reflexes can be observed.

We have seen that the vestibular organ can cause tonic and clonic contractions of the eye muscles. The first determines the position of the eye in the orbit.

Dr. De Kleyn and I tried to find out what are the different positions of the eye in the orbit when the head changes its position in space.

For this purpose we marked the cornea of a rabbit with a cross figure; suspended the rabbit in an operation board, the head fixed firmly in a Czermak clamp. At this clamp a wire figure was fixed, so that when we photographed the cornea we could see at the cross figure and the wire figure if and how much the cornea had moved. The photographic apparatus was fixed on the same board.

This operation board was fixed in a wooden frame in such a way that it could rotate on an axis and the frame again in another frame, so that it could rotate along an axis perpendicular to the first. In this way we could give the head of the animal every position in the space we wished.

When we turned the whole apparatus around a vertical axis the position of the eyes was not changed at all.

We made three rotations:

Rotation 1. Animal in vertical position, mouth fissure horizontal. Rotation of the animal on its bitemporal axis. Direction of rotation head down, tail up.

Rotation 2. Vertical position, mouth fissure horizontal. Rotation of the animal on its occipitocaudal axis.

Rotation 3. Animal in lateral position, mouth fissure vertical. Direction of rotation head down, tail up.

We made 25 photographs for every rotation of 360 degrees. The animal was moved every time 15 degrees, and we waited till nystagmus caused by the movement was over. At the twenty-fifth the animal had returned to its original position, so that the twenty-fifth photograph acted as control in determining if any change of the position due to other facts had taken place. It is clear that many of the positions in the three series are the same and so they controlled one the other.

In this way we learned that by changing the position of the head in space the eyes deviate typically in vertical directions and rotate along the sagittal axis. We could not find out typical horizontal deviation.

The vertical deviation has its maximum when the animal is rotated on his side; the eye of that side is as high as possible, the eye of the upper side as low as possible. De Kley and Magnus explained this by actions of the main part of the sacculus otolith. Every sacculus otolith is in connection with the rectus superior of its corresponding, the rectus inferior of its opposite eye. As long as the head is in a symmetrical position the influence of the muscles counterbalance each other, and so we see no vertical deviation, or practically none, when the animal is rotating around the bitemporal axis.

When, however, the animal leaves the medial position, the lower sacculus otolith drags more at its macula, the upper less, consequently the eye of the lower side is turned up, that of the upper side turned downward.

If one labyrinth is destroyed, the influence of the remaining sacculus otolith is not counterbalanced and the eye of the mutilated side is turned downwards, on the sound side upwards and the eyes return to the normal position only when the head is rotated on the mutilated side, so that the remaining sacculus otolith presses on its macula and so exercises no influence.

The rotation of the eye, the cyclotropia is maximal with the summit of the vertical to the nose when the nose is turned upwards; maximal with the summit to the ear when the nose is turned downwards. It was difficult to find out which oto-

lith produces this reflex, as neither the utriculus nor the main part of the sacculus otolith can do it. Now, Magnus and De Kleyn tried to explain it by action of the small bent part of the sacculus otolith. This part has not only a separate position nearer to the frontal plane, but also a separate innervation; whereas the main part of the macula sacculi is innervated by the nervus sacculus, this part is innervated by the nervus utriculus, so that it is no wonder when it has a separate action too. When the head is rotated with the nose vertically up in the air, the small part of the sacculus otolith drags at its macula and stimulates to the superior oblique muscles of both sides, so that the eyes rotate to the nose. When the head is rotated with the nose pointing downwards, these otoliths press on their maculae, and this produces a stimulus for the inferior oblique of both sides. When one labyrinth is removed the reflex is the same in quality but not in quantity. The weak point of this explanation is that we must here accept for the first time pressing on the macula as a stimulus, but it is possible that this explanation is good, though I have some other objections.

This rotating reflex is called the compensatory rotation, because it seems to try to compensate the rotation of the head by the rotation of the eyes. That really the labyrinth is cause of these deviations is proved by the fact that when we destroy both labyrinths the compensatory and vertical movements have disappeared when we examine the influence of the head movement without bending the neck of the animal.

I could show that these reflexes are absent in the congenital deaf dancing mouse and also in two congenitally deaf and dumb girls. For the examination of the latter I used a Javal ophthalmometer with a rotatable head rest in which the head was fixed. We first determine the axis of the astigmatism of the cornea and then we rotate the head with the headrest, for instance, at 10° ; when there is no compensatory rotation the axis of astigmatism is 10° rotated. If there were compensatory rotation of 10° the axis would not have changed; if the axis was changed 3° there must have been 7° compensatory rotation, so we can determine exactly the compensatory rotation in astigmatic human beings, and in doing so we find that even the least rotation of the head produces compen-

satory rotation. This is of importance for the ophthalmologist, for it teaches us that we must always put our patients with their head straight in the ophthalmometer, otherwise we cannot find the right axis. This compensatory rotation is also probably the reason that astigmatic people often hold their head rotated to one or the other side when they do not get the right correction. They try by this movement to rotate their eyes in such a way that they get their eyes in the best position behind their glasses.

We as investigators ask ourselves what is the purpose of this compensatory rotation? When this rotation was observed years ago, they thought it was to hold the vertical meridian of the eye vertically in every position of the head for better orientation, but this could not be accepted because the compensatory rotation was always less than the rotation of the head.

In rabbits it is, as you saw, the same, but we know that there is another influence which gives compensatory rotation of the eyes, namely, a reflex produced by the neck muscles.

When the neck of a rabbit is bent, the eyes rotate. Now, De Kleyn examined both separately: the compensatory rotation caused by the neck, by fixing the head and bending the body of the animal toward the head, and the labyrinth rotative reflex in the way above described. When De Kleyn put both compensatory rotations together he learned, as you see, that a rabbit with the mouth fissure horizontal, head straight forward, can lift his head over 10° and bend it downwards over 90° without rotation of the eye, because the compensatory rotations compensate fully the rotations of the head.

At first De Kleyn was puzzled as to why this compensation allowed the head to bend more than 90° and only to lift 10° . But this was easily solved, for the normal position of a sitting rabbit is not with the mouth fissure horizontal, head straight forward, but with the head bent downwards 35° , so that out of this position the animal can lift the head over 45° and bend downwards more than 55° without the vertical meridian of the eye changing its direction, which is quite enough for orientation in looking for his food.

So we see that in rabbits the compensatory rotation corrects the influence of the rotation of the head fully, and it is probable that in mankind this is atavistic.

In discussing the highly interesting problem of the vestibular nystagmus, I must be brief and will only speak of one point.

You know there are many excitations which produce vestibular nystagmus; one of them is the irrigation of the ear with cold water, the so-called cold water nystagmus.

Bartels holds that this is caused by elimination of the labyrinth by the cold, so that the same nystagmus is produced if one labyrinth has been destroyed. Barany, on the other hand, thinks it is caused by a stream of endolymph in the semicircular canals brought about by local cooling of the labyrinth wall. This cools the lymph at that spot, consequently this fluid gets heavier and it flows off towards the lowest part of the semicircular canal. The lymph stream stimulates the sensory epithelium of the ampulla and causes in this way the nystagmus.

At first Magnus and De Kleyn tried to determine if such a great influence as paralyzing a nerve in the ear can result from cooling of the ear. Now De Kleyn had discovered that in cats the sympathetic nerve of the eye runs through the middle ear, and they observed that irrigating the ear with cold water caused a palsy of this nerve in cats, narrow pupil, narrow eye slit, etc., consequently Bartels' explanation is possible, but De Kleyn and Storm Van Leeuwen could prove it is not right, because the nystagmus does not act in the same way as the nystagmus after labyrinth extirpation. Later these two experimenters proved that Barany's theory was correct in the following way:

De Kleyn and Storm Van Leeuwen thought if Bartels is right the nystagmus will be the same in whatever direction the head is held. If, on the contrary, Barany is right, there will be an ampullapetal lymph stream when the ampulla is lower down, an ampullafugal stream when the ampulla is higher up than the cooled spot; no stream when the whole canal is horizontal—that means that the nystagmus must change abruptly in direction when the cooled spot crosses the position in which it is on the level with the ampulla.

To examine this, De Kleyn and Storm Van Leeuwen used our rotating operation board and irrigated one ear of a rabbit.

during the rotation with cold water; they noted the direction of the nystagmus down after every 10° rotation so that the rotation of 360° gave 37 notations. You see here the result, which is corrected from the influence of the change of the direction of the internal rectus muscle by the rotation.

In no one of our three rotations does the horizontal canal really become horizontal, but we can reckon where the nystagmus must change its direction, and you see the result is very near to what was reckoned out before.

In this way it was proved that Barany's explanation is right. The cooling down of the horizontal semicircular canal plays the principal part in the genesis of cold water nystagmus.

If we review the different functions of the vestibular organ we find: Tonic reflexes on the body and neck muscles; Stell reflexes; tonic and clonic contraction of the eye muscles.

We always take for granted that the tonic reflexes are caused by the otolith apparatus, the clonic by the semicircular canals, but until now this has never been proved experimentally.

Whenever experimenters tried to take away the otoliths, the whole vestibular organ was spoiled, and the same was the case when they tried to perforate and drain the semicircular canals only. Now De Kleyn remembered that Wittmaak had published experiments in which he put guinea pigs in a centrifuge and revolved them about 2,000 rotations in a minute; then the centrifugal power was so great that the otolith membranes were torn and thrown away from the maculae.

Magnus and De Kleyn made use of this. They examined a great number of guinea pigs on every vestibular reflex, then narcotized them, put them in the centrifuge and revolved during two minutes at 1,000 rotations a minute. As soon as the guinea pigs awakened from the narcosis they were again examined on the vestibular reflexes, and this examination was repeated during a couple of days till nothing changed any more. Then the animals were given to the anatomist, who examined the labyrinth in serial slides.

Magnus and De Kleyn had made the clinical diagnosis of what had happened in the labyrinth, which otoliths were torn and thrown away. The anatomist made the anatomic diagnosis. They knew nothing of each other's diagnosis till they

made comparisons, and in nearly every case the clinical diagnosis proved to be right.

I can show you here microphotographs of normal otolith apparatus of the rabbit, of otolith membranes detached from torn otolith membranes partly detached and partly in place, of vestibular organs with large hemorrhages after the centrifuging, and after some experience the clinical diagnosis could nearly always be confirmed.

In this way the function of the otoliths and of the semicircular canals was for the first time proved, and it was determined that otoliths are the organs for the reflexes of position, the semicircular canals for the reflexes of movement, but there was only one surprising fact.

The reflexes of progressive movements, as lift movements, etc., proved to be caused by the semicircular canals, whereas Breuer had always said this to be absolutely impossible, and everyone had believed him.

Magnus and De Kleyn have already explained this fact, but it would take me too long to discuss it.

We cannot say with absolute certainty if the explanation of the action of every particular otolith which Magnus and De Kleyn maintain is correct, but we know these explanations to be probable and the facts on which they are based to be true. Others try to explain the otolith action in another way—e. g., Quix, who explains it by considering the pressing of the otolith on the macula as the one acting stimulus.

Mr. Chairman, Ladies and Gentlemen—In the first part of my address I recalled to your memory the manifold relations between eye and ear which we may encounter in daily practice. In the second I dealt with one of the most difficult problems of medical science, and therefore I do not flatter myself that every one of you will have understood everything I tried to express, but I am certain I have given you something to think about. You see that we are not at the end of all the problems, how after every solved problem new questions arise which await their solution, but I hope you are convinced with me that we are on the right track and will, in going on in this way, come to know as much of the functions of the vestibular organ, as much of the relations between labyrinth and eye, as is given to human beings to know.

XLVIII.

METASTATIC LARYNGEAL ARTHRITIS.

By S. O. FIELDS, M. D.,

NORFOLK.

From the paucity of the literature on the subject of joint affections of the larynx one is almost forced to conclude that the condition is either an extremely rare one or else that observers do not make the diagnosis often owing to certain inherent difficulties in and obstacles to accurate observation. Taking into consideration the fact that there exists no insurmountable pathologic or anatomic reason why the laryngeal joints should not be subject to the metastatic conditions affecting the other joints of the body, the conclusion is obvious that the rarity of the affection is merely apparent rather than real, and that the difficulty lies in properly interpreting the often indefinite and elusive symptoms and in correctly translating the not infrequently vague physical manifestations.

The etiologic factors of the condition are manifold at first glance, but a simplification is possible if these causative factors are regarded from three fundamental viewpoints. First, we meet with the affection in such general infections as typhoid, influenza, syphilis, tuberculosis. Secondly, it occurs as a concomitant manifestation of involvement of contiguous tissue, as in the cases in which a perichondritic or phlegmonous process makes itself felt in the joints of the larynx. Thirdly and most important of all, the condition is encountered as a local manifestation of a distant infectious process. This last view, or view of metastatic focal infection, occupies the most important position in the etiologic scale and harmonizes entirely with what we know of similar processes taking place in the other articular structures of the body. It is as logical that the joint structures of the larynx should be involved in an individual with infected tonsil, nasal sinus trouble, abscessed teeth, or a posterior urethritis, etc., as it is for the knee or elbow joint to be likewise attacked under similar circumstances. That in these metastatic cases there

is some additional factor determining the localization of the bacterial activity to the laryngeal joints aside from a selective affinity of the causative organisms we feel reasonably certain; for in three of our four cases herein reported it was only after the occurrence of intercurrent factors producing probably a more or less marked hyperemic state in the larynx that the joint manifestations were evident. So it is likely then that in addition to having the selective bacterial agents we must also have the proper preparation of the soil.

When we come to the pathologic features characteristic of laryngeal articular involvement we are forced to confess, if we are frank, that our knowledge is woefully deficient. Not enough postmortem work has been done in the condition to render us any appreciable amount of help. We know that the cricoarytenoid joint is affected in the vast majority of the cases which present themselves. Sometimes the affection of the laryngeal joint is found alone and sometimes it is seen as an accompaniment of a general polyarthritic condition. Reasoning from analogy and from our knowledge of similar processes in the other joint structures of the body, there is little doubt that we have the characteristic serous exudation into the joint cavity, the typical round cell infiltration, the hyperemia, the swelling, often the infiltration of the periarticular tissues, and if the process is a chronic one the deposition of cicatricial or connective tissue, within or without the joint capsule, often going on to partial or total ankylosis.

The symptoms of the condition are in not a few instances so vague and indefinite that their correct interpretation presents quite a problem. In character they range from manifestations which are only suggestive to those which are well marked and clear cut. On the one hand, there are met cases presenting solely a history of paresthesia of the laryngeal region and a variety of indefinite complaints, and on the other are encountered cases which present every type of pronounced laryngeal irregularity—e. g., pain, hoarseness, dyspnea, etc. The patients in the less severe cases complain simply of a sensation of fullness or tension or itchiness in the throat, situated in the lateral region of the larynx and aggravated especially by swallowing or speaking efforts or on touching the spot with a probe. In addition the patient may com-

plain of a sensation of using the voice under a strain. In nearly every case, whether mild or severe, there can be obtained the history of some event or occurrence about three or four days prior to the laryngeal joint manifestation of sufficient degree to provoke a hyperemia or irritation of the laryngeal mucous membrane. The pain encountered in the more severe cases is often quite intense and manifests a tendency to radiate upward into the ear or downward along the sternomastoid on the affected side, but in our experience this pain does not approach in severity the type encountered in phlegmonous laryngitis or in perichondritis. Neither is the hoarseness so pronounced or the dyspnea so marked as in the latter affections. A typical feature of the affection which was present to a greater or less degree in our cases was the so-called Grünwald's crepitation, this sign being elicited by intermittent pressure on the upper and back part of the thyroid cartilage and being characterized by a peculiar grating or "moist rale" sensation which can be both felt and heard, this sound owing its origin to the rubbing together of the inflamed articular lining.

On examining the larynx we find in the majority of cases a slight amount of redness over the arytenoid cartilage and also a moderate amount of swelling. Both the reddening and the swelling vary according to the severity of the affection, but in most instances they are not very marked, and the redness in most cases presents in addition a rather streaky appearance in striking contrast to the diffuse reddening noted in other conditions affecting the region of the arytenoid cartilages. The vocal cord shows impaired motility and not infrequently presents a jerkiness of motion which is evidently due to the increased friction between the roughened synovial surfaces. Absolute fixation of the cord and the presence of scars and adhesions are evidences of a severe process which has lasted a long time and are seldom seen as a result of metastatic laryngeal joint trouble.

Though it is fairly difficult in some cases to differentiate the condition from perichondritis, paralysis of the cord, etc., still careful analysis of the history and keen observation of the course of the process render a correct diagnosis by no means a matter of impossibility. It is highly important to

remember that these joint affections, like similar affections in the other joints of the body, have in the majority of instances, a primary focus of infection to which they owe their origin. The acuter cases are prone to undergo resolution subject to recurrences, unless through careful search we ascertain the original site of infection, but if the process enters upon a chronic adhesive stage or if it is of that type from the beginning we are likely to have as a result adhesion, stenosis and other disastrous sequelæ.

The following cases are likely to prove both interesting and instructive because they represent, with one exception, types of laryngeal joint affection due to metastatic infection:

Case 1.—J. L., male, age twenty-eight, single, negative family and past medical history, came from Margarettsville, N. C., to the Princess Anne Avenue Clinic, complaining of pain in the right side of the larynx on swallowing or speaking, and marked sensitiveness to pressure over the upper and outer part of the thyroid cartilage. He stated that six days previous to his first visit he had attempted to inhale steam from very hot water for a condition which his physician had called "catarrh in the head," and the vapor being almost scalding had pained him severely. He paid no attention to the matter, for it seemed to be all right in a few hours. About three days afterward his present throat trouble developed. His voice, while not strictly hoarse, exhibited a roughness or huskiness which caused him to clear his throat constantly in the effort to raise what seemed to him obstructing mucus, thereby aggravating the existing pain. Laryngoscopically there were found slight swelling, delimited to the region of the right arytenoid, and a little streaky reddening over the same structure. The vocal cord exhibited characteristic jerky movements. There was tenderness on pressure, and Grünwald's sign was easily elicited. Urine, pus threads. Wassermann, negative. General examination negative save for a moderate degree of swelling and pain in the right knee which came on about ten days ago, three weeks subsequent to the onset of a urethral discharge diagnosed as clap. Staining and microscopic examination of a centrifuged specimen revealed the gonococcus. Following the institution of treatment for his urethritis, combined with the use of vaccines for his gonor-

rheal knee, the throat condition rapidly improved, and in two weeks he reported himself normal, both as to knee joint and throat. An examination made at this time showed normal cord motility, an absence of pressure tenderness and the disappearance of Grünwald's sign.

Case 2.—E. S., female, high school pupil, age 17, subject to recurrent attacks of tonsillar inflammation, tonsils being of the submerged buried type, crypts containing pus. Sometimes during her tonsillar attacks she experienced pain in her knees, elbows and wrists. Past medical and family history irrelevant. Wassermann, negative. Urine, normal. General physical examination, negative. Five days before coming under observation, while imitating another schoolmate, she had attempted to smoke a cigarette. She states that her efforts were only indifferently successful, for nearly all the smoke "went down into her windpipe" every time she attempted to blow it through her nostrils, and she sputtered and coughed and choked for nearly fifteen minutes before abandoning her maiden effort to be a devotee of modern fashion. She dismissed the matter from her mind and thought no more of it until two days later, when she noticed that the region of her larynx was painful and tender to pressure. The pain of which she complained ran down along her sternomastoid on the left side. While her speech was not distinctly hoarse she showed a coarsening of a voice which was normally most delightful to hear. Her tonsils at this time showed evidences of a recurrent inflammation, and in addition she complained of slight fugitive pains in both elbows and knees. Laryngoscopically the typical slight reddening and the moderate arytenoid swelling were visible. The movements of the right cord were normal, but those of the left were much inhibited. Grünwald's sign was obtained. Despite the subacute process in the tonsils they were removed, with immediate improvement in the patient's laryngeal condition and the disappearance of the pains in her other joints. Since that time she has had no more trouble.

Case 3.—C. H., female, married, age 48, had experienced annoying pain and sensitiveness in her right upper canine tooth ever since a dentist had put in a filling a year before. She also suffered severely with "rheumatism," so that at

times she was well nigh incapacitated from the pain and stiffness in her joints. She came into the throat department of the clinic complaining of a peculiar itching and drawing sensation in the right side of her larynx, which at times amounted almost to actual pain. Though her husband stated that he could detect a slight change in the timbre of her voice, she herself asserted that it was not pronounced, and that her chief concern was the unpleasant feeling in her throat. Past medical and family history negative. Wassermann negative. Urine normal. General physical examination negative. Deep pressure over the thyroid cartilage showed slight and questionable tenderness on the right side. Grünwald's sign present. Characteristic reddening and swelling over the right arytenoid. Almost no impairment of motility of the vocal cord, although the right cord showed a moderate amount of jerkiness in its movements. Finding nothing to account for her general or laryngeal joint manifestations save the sensitive tooth, an X-ray was made, and this revealed a fairly large apical abscess. Removal of the tooth was followed by progressive improvement in every respect, and at her last visit, three weeks later, the patient stated that she felt better than ever before in her life. Laryngoscopic examination at this time revealed a perfectly normal condition of the laryngeal structures.

Case 4.—P. T., widow, age 52, came under observation July 8, 1921. History of several miscarriages. She stated that for several years she had suffered from vague fleeting pains and aches in all her joints and muscles. About five days previously, so she stated, she swallowed a large drink of tea "the wrong way," and as a result she had a severe coughing and choking spell for nearly half an hour. Two days afterwards she noticed that the region of her larynx was moderately painful on swallowing and speaking, while there was considerable soreness on both sides when she made pressure on the painful area. Her voice was moderately husky. Grünwald's sign easily elicited. Laryngoscopically the moderate swelling and arytenoid reddening were noted, bilateral in this case. Slightly impaired motility of both cords. General physical examination negative. Urine normal. Wassermann plus four. Despite the most thorough search no focus of infection was discoverable. Intensive antiluetic treatment was then begun, on the

basis of the positive Wassermann and the history of many miscarriages. In ten days her laryngeal symptoms had vanished, followed soon by the disappearance of the vague joint and muscle discomfort. When last seen, about six months ago, her larynx presented a normal condition and she asserted that she felt like a new woman.

An analysis of these four cases reveals in every instance—even in the luetic case—that the actual onset of laryngeal articular trouble was preceded by some occurrence which probably sufficed to render the laryngeal structures a locus minoris resistentiæ. It also serves to emphasize the fact that focal infections are to be taken more into consideration in these cases, thus broadening the scope of a field already of no inconsiderable magnitude. Furthermore, it shows the necessity of taking up the subject of laryngeal joint affections again and revamping many of the pet theories which we have held all along concerning the matter. If, in this imperfect and preliminary study, we have succeeded in focusing a little attention on the subject we shall feel that our efforts have not been in vain.

1008 CHURCH STREET.

SOCIETY PROCEEDINGS.

CHICAGO LARYNGOLOGICAL AND OTOLOGICAL SOCIETY.

Meeting of Wednesday, November 1, 1922.

THE PRESIDENT, DR. CHARLES H. LONG, IN THE CHAIR.

PROF. ROBERT BÁRÁNY, Upsala University, Sweden, delivered an address entitled:

"Oto-Neurology and the Necessity of Co-operation Between Ear and Eye Specialists, Neurologists and Brain Surgeons."

Professor Bárány took up, first, the historical development of various tests in connection with otologic and ophthalmic work. He stated that the anatomy of the vestibular apparatus had been known for several hundred years. Many sane observations had been made, but there were many speculations. For instance, during an attack of vertigo involuntary eye movements occurred, but no one in those days took the trouble to investigate why these eye movements occurred. Purkinje had the opportunity to observe the eye movements in vertigo in cases of insane people, who were placed in cages and turned around until they became nauseated, and eventually they quieted down. While this treatment was said to be effective, it did not seem humane. Purkinje studied the eye movements of these patients and found that under normal conditions eye movements were obtained by holding the head in different positions, and different results were secured, and Purkinje came to the conclusion that it was the head which was directly influenced by the drum. But he drew a wrong conclusion; it was the brain which was irritated by the drum. There must be a sense organ before the brain could get a sensation, and Purkinje thought the brain got the sensation directly. In the same year that Purkinje was doing his work Fleuron made some experiments on pigeons. He dissected the different canals in pigeons and found that when he dissected the horizontal canal, which lies in a horizontal plane, the pigeon turned in a horizontal plane; that if he dissected the vertical canal, the pigeon

would make curious movements which he could not understand. He did not think these birds were dizzy, and that it was vertigo which produced these movements. Purkinje was familiar with dizziness in man but not the dizziness of animals. He came near making a discovery, and if he had turned one animal he would have seen the difference between the dizziness of man and the dizziness of animals. Other men repeated the experiments of Purkinje and Fleuron without discovering anything especially new. In the year 1861 Meniere's disease was brought to the attention of the profession. At that time Meniere was sixty years of age, and his discovery was considered unusual but it was accepted. He had practiced as an ear specialist for many years, and frequently saw cases in which dizziness occurred. At this time, if patients presented themselves with attacks of dizziness he immediately made a diagnosis of cerebellar tumor. He had made several autopsies in such cases and had found cerebellar tumor in some of the cases. Meniere studied his cases carefully and found some patients who had had dizziness for thirty years but who never developed cerebellar tumor, so that he came to the conclusion that his diagnosis of cerebellar tumor was incorrect when based on dizziness alone. He began to look for some other explanation and found these cases always had dizziness, tinnitus and earache, although the ear drums were normal. The tuning fork was unknown at that time, but Meniere concluded from these other symptoms that these patients must have some lesion of the inner ear. The cochlea was for hearing, but it was not known what importance the semicircular canals had. Meniere received inspiration from the experiments of Fleuron and believed dizziness was the cause of the movements of the eye in animals without ever having turned an animal or examined it himself. He came to the conclusion that the dizziness of patients was due to some disease in the semicircular canals. It was subsequently pointed out that he was right in reaching that conclusion. He published several articles on what is known as Meniere's disease prior to his death. It was thought that Meniere's death did much to promulgate his theory, because Dr. Bárány believed that if he had not died his colleagues probably would have fought him, but instead they made a national hero of him.

In 1870 a German physiologist by the name of Glotz repeated the experiments of Fleuron and advanced the theory that if the semicircular canals were diseased the animals lost their equilibrium; therefore, it was probable that the function of the semicircular canals was to maintain equilibrium. Other men who made observations and experiments were Breuer and Mock of Vienna and Brown in America. Brown in turning animals saw that he produced the same movements as by dissecting the semicircular canals. He maintained that irritation of these canals was the cause of dizziness, because it was very clear the animals became dizzy. On the other hand, if he destroyed the canals on both sides the animals were again made dizzy. He advanced the theory that the movements of the endolymph, produced by turning, were the cause of irritation or of stimulation of the canals. Mock came to the same conclusion by other experiments which he made, but in a logical and philosophic way concluded that all the other causes could be excluded, and only the semicircular canals remained to produce the sensation of turning. Brown examined normal individuals with turning sensation in different positions of the head and said there could be no question that it must be the semicircular canals which produced sensation because the brain could not directly take its position. These men were not ear specialists, consequently ear specialists for a long time did not appreciate this theory on the ground that they had not found pathologic cases. Some examinations were made of deaf-mutes after the turning method of Breuer, but except for these findings there was not much learned. Quite a number of men had made valuable observations; among them Jansen of Berlin, who saw a large number of cases of fistula or lesions of the labyrinth, and was one of the first to advocate operating on the labyrinth when it was suppurating.

When the speaker began to examine these patients he had received three years' training in the clinic of Politzer of Vienna and had studied the literature on the vestibular apparatus in which he became very much interested. At the clinic he syringed those cases that had fistula of the attic of the tympanum and in so doing observed the patients became dizzy. From what he had read of the work of Breuer, it was clear to him in looking at the eyes that nystagmus was present. When

he syringed the right ear he noticed nystagmus to the left. This observation was noted on a sheet of paper which he put in his pocket. The next day he had another case of nystagmus which was treated in a similar way. He recorded this observation on a sheet of paper and put it in his pocket. In a short time he found he had something like twenty such cases that he had recorded and was astonished to find that he had always observed the same thing. He found that if he syringed once on the right side, and then the left side, he became confused, and it was clear to him that there was a law behind this, but he had no idea what that law might be. One day one of his patients came to the office and when he syringed his ear again the patient exclaimed, "Doctor, the water is too cold; when I syringe the ear myself at home I never get dizzy." The speaker then said to the nurse that the patient had complained of the water being too cold. The nurse in reply said it was not true; the water was not cold, as she had tested it with her finger.

The speaker pointed out the necessity of having the water warm. Subsequently the nurse made the water very warm and, after syringing the ear again, the patient exclaimed, "Doctor, I am again dizzy; the water is too hot." As Professor Bárány looked at the patient's eyes he immediately saw that the water had produced the opposite nystagmus. It was the temperature of the water which had produced this opposite nystagmus. This observation was a step to other conclusions. If it was the temperature of the water which produced this effect in suppuration of the attic, might not this phenomenon occur in other cases? He examined other cases after syringing with cold and hot water and found that all cases with normal drums showed the same phenomenon, only it took a little longer time to get it, as in a case where there was no drum. Up to this time he did not know how cold and hot water could influence the labyrinth to produce this nystagmus, but one day he saw an explanation for it. (Here Professor Bárány with the aid of blackboard diagrams showed how hot and cold water could influence the labyrinth sufficiently to produce nystagmus.) He found that if the labyrinth on one side was destroyed he did not get this reaction, so he sought for cases that had no reaction and he found such cases with no caloric re-

action, and when operated on it was found the labyrinth was destroyed, with the presence of cholesteatoma. The clinical value of the test became evident to him, and it was now possible to examine every vestibular apparatus. If one syringed the right ear with cold water, nystagmus was produced, the patient became dizzy, so that when he closed his eyes the sensation was of turning to the left side. He found subjective dizziness on turning sensations.

There were reflex reactions upon other muscles of the body besides the nystagmus. Such a nystagmus could be observed in man. If he got a falling reaction he could not stand erect with his feet together in the Romberg position; he would slowly fall to the right side. If his head was turned to the left side the falling was changed; he fell forward. If he turned his head to the right side he fell backward.

In thinking about the mechanism of the falling reaction, he employed a method which he found had been developed by Exner, a physiologist, who had written a book on the subject. Exner, he said, tried to construct mechanisms in the brain or in the spinal cord which would produce physiologic effects. These mechanisms were constructed upon the neuron theory. The speaker had found this method of Exner's valuable for constructing mechanisms in the brain and also for the vestibular apparatus. Possibly somewhere in the brain there was a cell which received its impression, and through this cell there was innervation down to the spinal cord, so that the patient fell to the right side. There was some stimulation of the semicircular canals during the turning of the head which produced this change. He found that if he held the head in the same position and turned the body and not the head, he got the same change, so that the cause of this change was not in the head, it must be in the connections between the head and trunk, and he came to the conclusion that it must be in the deep sensibility of the neck. After making other observations and tests he saw there was a double influence exerted on one center, and the question was, Where was this center situated? This center received impulses from the semicircular canals and impulses from the deep sensibility of the neck.

He then studied the literature on the histology of the brain to see if he could find where this center might be. He thought

it might be the principal nucleus of the vestibular nerve, but he could not find this center in the deep sensibility of the neck. He found, however, the deep sensibility of the neck extended into the cerebellum, and therefore he concluded that it extended into the vestibular cerebellum and not into the medulla oblongata. If the vestibular mechanism was destroyed he was not able to get this influence. Then he went to work to find out if there was disease in the cerebellum. He found such a case on which an autopsy was held, showing a tumor in the cerebellum. Several months later he was called upon to make a diagnosis in a case where neurologists could not find out on which side of the cerebellum the tumor was situated, and he was asked to find it out by his method of examining the right and left ears. After making tests he was not sure himself on which side the tumor was located, but finally decided it was on the right side. It was subsequently found that the tumor was on the left side.

He began to study the literature on the subject and found an interesting book by Bolk on the cerebellums of mammalia. In this book Bolk presumed that the cerebellum had something to do with innervation of the muscles and compared the cerebellums of different mammalia with each other. He found the giraffe had an enormous neck, well developed, while the neck was nearly absent in the mole, and he concluded that this part had to do with the innervation of the neck. After comparing the cerebellums of different animals he concluded that the hemispheres of the cerebellum must have something to do with the innervation of the extremities, and the middle part of the cerebellum had to do with the innervation of the trunk. In one case he found a tumor was situated in one hemisphere and not in the vermis, and therefore could not make the diagnosis before operation. By the pointing test he found innervation of the extremities in the same way as innervation of the musculature of the trunk and falling reaction.

The pointing test and falling reaction were not such simple reactions as nystagmus. Nystagmus was quite independent of the will of a person. Fixation could diminish the nystagmus and sometimes inhibit it, but if fixation was excluded one could see nystagmus exactly as it was without any influence upon the side of the person. The falling reaction was influ-

enced by voluntary movements. If we got such innervation in the right side, a person could fall to the left side, so that the reflex movements were not so easy of investigation as nystagmus.

Pathologic ear cases were more frequent than cerebellar lesions. Tumor cases were difficult because the tumor was only damaging the parts where it was situated, but the whole brain was being pressed upon in different directions, producing hydrocephalus and a number of symptoms, so that these cases were not so simple as the ear reactions in diseases of peripheral organs. Therefore it was necessary to have the cooperation and collaboration of many men to develop this work. There was still an enormous amount of work to do which would take many years, and specialists should cooperate in every way in carrying out further research work, which would eventually result in not only great benefit to the patients themselves but to mankind in general.

DISCUSSION.

DR. GEORGE W. HALL said that Professor Bárány had rightly stated the difficulty of exact localization in cases of brain tumor because of pressure in distant parts of the brain, and he would like to ask him for information what light he could give from his tests in cases of occlusion of the posterior inferior cerebellar artery, which causes certain vestibular manifestations?

PROFESSOR BÁRÁNY replied that he had examined two or three cases of occlusion of the posterior inferior cerebellar artery, and in one case there was marked nystagmus, which was to be explained by a lesion in the medulla, which occurred near the nucleus descendens of the vestibular nerve. He had seen severe disturbances of equilibrium in these cases, and the question arose whether it was the nucleus which was affected, which had connection down to the spinal cord, or whether it might be a lesion extending into the cerebellum and causing trouble there. He had also observed that certain pointing reactions were not present in such cases. If it was a lesion of the cerebellum or of the tract traveling down into the medulla oblongata, if certain pointing reactions were not present, then probably the lesion was in the cerebellum and hemisphere, and not in the medulla oblongata.

He had not been able to make autopsies on any of his cases, but he mentioned one case reported in the literature by a German in which a postmortem was made and the findings corroborated the symptoms manifested during life. In most of the cases that came to postmortem he said these tests had not been made; if they were made, they were incomplete, and it was not possible to reach a correct conclusion if one did not make a complete examination. In some of the cases he had seen reported in the English literature, in which spontaneous pointing was found and eye pointing reactions to the turning or syringing, there was only an examination of pointing in one plane and not in the other. Incomplete examinations did not help very much. In such cases there must be an exact examination, and then it would be interesting to compare these examinations with the autopsy findings. These cases were suitable for drawing deductions because the tumors were not pressing and making other symptoms.

DR. GEORGE E. SHAMBAUGH stated that there was one practical question which often confronted a physician, and that was the question as to whether in cases of vertigo the disturbance arose from the internal ear or from an intracranial disease. It must be quite clear to everyone present, from what Professor Bárány has just said, that vertigo and disturbance of equilibrium could be produced as readily from diseases of the posterior brain fossa as from alterations in the internal ear. Dr. Shambaugh believed that the otologist was able with very few exceptions to determine definitely whether the disturbance of equilibrium arose from internal ear disease or whether it was being caused by intracranial trouble.

This was always the first important question to determine in the cases of vertigo. He was not so confident that our interpretation of the reactions obtained by applying the Bárány tests, as they were now called, had reached such a point that we were able in many cases to determine anything more than that we had to deal with a disease in the posterior brain fossa. His experience had convinced him that these tests, when properly applied, and where they were properly understood, would often give a definite clew regarding the existence of some obscure intracranial condition much earlier than the neurologist could find any evidence of these conditions.

DR. H. I. DAVIS said it was not easy for the neurologist to answer certain questions, as was proven in a case seen by Professor Bárány and himself. The patient had had attacks of dizziness and disturbances of equilibrium and at one time mild-epileptic seizures were suspected. On investigation the patient was satisfied that she had never lost consciousness during any of the attacks, and after repeated examination it was thought that the labyrinth might be responsible for them. When the patient was carefully examined by Professor Bárány the presence of moderate nystagmus was disclosed, and the question was settled in favor of the labyrinth.

DR. ARCHIBALD CHURCH was gratified to learn that even Professor Bárány still found difficulty in the interpretation of these complexes. The speaker had the impression that in one or two conditions a definite combination of symptoms developed. In these caloric tests, the turning test, the pointing test, and falling inclination were quite precise, as, for instance, in tumors of the pontine angle—the acoustic tumor in particular. He had a feeling that the neurologist picked out these cases as soon as the otologist, and he recalled several patients whom otologists had accused of having cerebellar and brain tumors because of some modifications in the responses induced by the Bárány tests. These patients had some bad moments under the impression gathered from the otologists that they were the possessors of brain tumors. However, this supposition was not verified by the clinical histories extending over a period of a year and a half, two and three years, respectively. The interpretation of these signs and symptoms was extremely difficult, and what at first promised to give an easy avenue to correct diagnosis of a localizing character, he was afraid in the great majority of cases only served either to confirm the neurologic observations or else to confuse them. The subject was one in the study of which all should cooperate. The fruits only would be gathered after much data had been carefully collected and thoroughly sifted.

DR. J. HOLINGER thought every one, after listening to the remarks of Professor Bárány, got the impression that it would take an enormous amount of joint work on the part of pathologist, neurologist, physiologist, ophthalmologist and anatomist in order to work out all the questions that were involved.

He believed we have no facilities to undertake such work. Many beautiful views had been opened up in various directions, but we have no men, no clinics or laboratories to undertake these investigations. The facilities for doing such research work are not at our command either in Chicago or in any other great medical center in the United States. It was high time for specialists to begin to work jointly in order to get an insight into the complicated workings of the brain, eye and ear for the best welfare of patients and of humanity in general.

DR. CLARENCE A. NEYMANN inquired of Professor Bárány about those cases of psychogenic pseudonystagmus with certain of the other reactions that recover or are improved after psychoanalysis. He recalled the case of a young girl whom Professor Bárány had seen in St. Louis. This girl showed certain reactions as to past pointing, etc. She was totally incapacitated for work until a definite psychic complex was unearthed. She still showed some reactions, but improved as regards dizzy spells and was able to work.

He had had several other cases in which there were attacks of tinnitus aurium, dizziness or vertigo that had done remarkably well under this sort of treatment, and he asked Professor Bárány if any psychic influence could change these tests.

PROFESSOR BARANY, in replying to Dr. Neymann and in closing the discussion, stated that he had never seen hysterical nystagmus. It was possible, however, that hysterical patients could produce eye phenomena, such as convergence, which was not at all infrequent. It was possible for a patient to produce voluntary nystagmus. He knew of men who could produce voluntary nystagmus and he could do it himself.

Another thing: hysteria was produced by disease of the vestibular apparatus very often, and then it was possible by treatment to improve the hysterical symptoms. For instance, he had seen a woman with moderate attacks of nystagmus, and by stimulating eye movements from the vestibular region she felt very dizzy. It was possible by some means to get rid of this sensibility to nystagmus.

As to the girl he saw in St. Louis, the patient was not cured by psychoanalysis. She had quite definite trouble when he saw her after treatment. Probably her hysterical psychosis had been improved, and one could by treating the hysterical

psychosis or hysterical symptoms get improvement, but a real hysterical nystagmus he had not seen. It was quite another thing with the past pointing which could be produced voluntarily. One could past point and this could be influenced by hypnosis and by other methods. He had a patient in Upsala who had dizzy spells with nystagmus and past pointing. One day he got the idea of putting a noise apparatus in her ear, which he did, and then the past pointing completely disappeared. In another case he used a tuning fork on the skull and the past pointing disappeared. The past pointing could also be made to disappear by psychoanalysis.

He did not believe that hysteria was a disease situated in the medulla; that hysteria was a subcortical disease and was not situated in the medulla oblongata, nor in the vestibular nerve. One could detect spontaneous nystagmus by tests, also spontaneous past pointing. There was a diminution of certain reactions in tumor cases where neurologists had not found anything. He saw such a case recently at the Mayo Clinic.

If one desired to make an accurate diagnosis in these cases he must be familiar with the various apparatuses: otherwise he would make mistakes.

CHICAGO LARYNGOLOGICAL AND OTOLOGICAL
SOCIETY.

Meeting of Monday Evening, December 4, 1922.

THE PRESIDENT, DR. C. H. LONG, IN THE CHAIR.

Impaired Voice.

DR. ELMER L. KENYON presented a young woman of twenty-seven, a teacher, who had had a uniformly impaired voice for about twenty years. No physical cause in the larynx was evident excepting a bowed action of the vocal cords on phonation. The case would ordinarily be classified as a functional neurosis of the intrinsic muscles of the larynx. But since the intrinsic muscles could not function without cooperation of the extrinsic laryngeal musculature the old habit of studying only the action of the intrinsic musculature in such cases was evidently wrong. In fact, in this case the action of the extrinsic musculature was also evidently imperfect. Dr. Kenyon believed the trouble to be one of imperfection of vocal technic acquired in childhood and that the trouble was correctable by vocal training.

The patient had an acute illness when she was six or seven years old and before that had sung in a very high voice. Possibly during the acute illness she had had a laryngitis and had found it necessary to strain the entire musculature to produce an intelligible voice. As this continued for some time, she may have formed a bad habit of handling the voice and this habit may have persisted. Dr. Kenyon believed that in functional cases one should obtain accurate information as to the manner in which the extrinsic musculature varies in action from the normal and in this way such cases may possibly be placed upon a firm basis of understanding.

DISCUSSION.

DR. NORVAL H. PIERCE thought Dr. Kenyon opened up a very interesting field in his attempt to study the extrinsic muscles in the act of phonation. There was no question as to the fact that they had much to do, especially with the singing voice, but he thought it would be difficult to tell whether they were

acting properly or not. It was quite easy to tell the actions of the intrinsic muscles. It was not so easy to determine the action of the extrinsic.

DR. KENYON said that in the falsetto voice of puberty and in dysphonia spastica one could observe a definite disturbance in the action of the extrinsic musculature of the larynx. In certain other disorders of voice, like, for example, the one in question, the tendency to imperfect action was also clear, but not so positive. Since the intrinsic muscles could not function excepting with the cooperation of the extrinsic, the old habit of studying only the action of the intrinsic muscles for an explanation of their imperfection of action was evidently wrong. If one is to solve functional disturbances of the voice it must be by observation of the complete musculature on which vocal cord action depends, and not by observing merely one phase of such action.

One studies, mostly by palpation, the action relationship between thyroid cartilage and hyoid bone, and between these structures and the base of the tongue, the sternum and the spinal column. Definite sounds are given for purposes of such observation. Dr. Kenyon was attempting to accumulate facts in a variety of functional vocal disturbances. The X-ray might eventually be of service. In the patient in question he believed that vocal training would bring about recovery.

Ozena.

DR. ALFRED RUNDSTROM presented two cases of ozena, the first case one of genuine ozena, and the second one of hereditary luetic ozena.

Dr. Rundstrom saw the first case for the first time two years ago, and at that time the nasal cavities on both sides were filled with fetid crusts. The meati were wider than normal; the inferior turbinate bone was already atrophic, the atrophy more apparent on the skeleton than on the mucous membrane. He had removed the concha media on both sides and opened the ethmoid cells and the sphenoid sinuses on both sides. In all these sinuses there was a carionecrotic process. The left side at this time was perfectly healed. On the right side there was still some secretion, but the naked bones were now partly covered with mucous membrane, partly with granulations.

The second case, as already stated, was one of hereditary luetic ozena. In this case also the ethmoid cells and the sphenoid sinuses on both sides were the seat of a carionecrotic process. Dr. Rundstrom stated that these two forms of ozena resembled one another very much, although they were different as to etiology. This confusion happened so often that some authors, as was well known, claimed that genuine ozena always developed on a luetic basis. Resemblance consisted in the fetor and the carionecrotic process. The difference was that in the luetic ozena the carionecrotic process causes greater destruction and that these destructions may also be found in the nasal cavity, while in genuine ozena they are found only in the sinuses. While the carionecrotic process was present in both forms of the ozena it was caused in the first by pus infection and in the second by a luetic infection.

DR. MILLARD F. ARBUCKLE, St. Louis, addressed the society on

"Complications of the Naso-Sinuses:"

ABSTRACT.

DR. ARBUCKLE said that on October 20, 1922, he presented to the St. Louis Pediatric Society a few cases of acute parenchymatous nephritis, sometimes called nephrosis, in which the results following treatment in suppurative diseases in the nasal accessory sinuses had been sufficiently noteworthy to justify reporting them.

They have had about twelve cases at the St. Louis Children's Hospital and in private practice. In these cases there was marked general anasarca, albumin in large quantities in the urine, casts and red and white blood cells also present in some. In all the cases, except one, suppurative disease in the nasal accessory sinuses was found.

In view of subsequent experience, he believed there was sufficient evidence in that case to justify the diagnosis of ethmoiditis and sphenoiditis, since the mucosa in the olfactory fissure was red and thickened. In some the antrum alone, either on one or both sides, was involved and in some the upper nasal cells alone were involved. In all cases, except the one just referred to, improvement in the general condition was noted so quickly after improvement in the nasal condition that

it seemed certain the nasal suppurative process was the causative factor for the kidney condition. This single case just referred to died without improvement.

In one case of antrum suppuration seen first February 5, 1922, the results were most striking. The antra were irrigated on several occasions and quantities of pus were recovered by irrigation. Immediately after this there was rapid loss of edema, and the chemical and microscopic findings in the urine at once began to return to normal. After about ten days there was an increase in the edema and in the amount of albumin and microscopic findings. The antra were irrigated and found to contain pus. Improvement like that noted after the first irrigation again occurred. This treatment was repeated on several occasions within a few weeks with similar results in each instance. This case was a fair example of the results obtained in cases of antrum suppuration. In some cases of suppuration of the upper nasal cells the nose was treated by the instillation into the nose of 1 per cent mercuriochrome (220) solution twice daily. There was rather prompt and continued improvement in the suppurative process in the nose. As in the other case the improvement in the general condition was parallel to that in the nose. After the urine had become normal, generally in ten days to two weeks, these children were placed on normal diet without any recurrence, so far, of the kidney condition after the nasal condition had cleared up.

Prior to the institution of nasal treatment they had failed to respond to the treatment usually given these cases, rest, special diet, etc. The following case reports were given:

"Case 1.—A six-year-old child was brought to the office May 27, 1921, complaining of nasal obstruction and sneezing. It was noted that she had a chronic inflammatory process in the sphenoid region on both sides and a sufficient mass of adenoids to cause the nasal obstruction. The adenoids were removed and with local treatment of the nose the inflammatory condition cleared up considerably, although at times she was inclined to have a condition which was suggestive of hay fever.

"On March 27, 1922, a pediatrician asked me to look at her nose to see whether there was any cause there for headaches and fever. There was a history at this time that she had re-

cently had what the family called "flu," which was a moderate epidemic of rather severe nasal infection which was prevalent at the time. It was noticed that her face was slightly swollen and puffy beneath the eyes. There was pus in the middle meatus on both sides and swelling of the middle turbinates. There was heavy golden yellow pus in the nasopharynx, apparently coming from the sphenoid. Urinary examination disclosed a very active acute parenchymatous nephritis. Swelling of the face, legs and abdomen continued until about April 3rd. Since March 27th she had been on daily nasal treatments and rest in bed. On April 7th, her condition was very much improved. There was much less pus in the nose, and it was also noted that her general condition improved coincidentally with the nasal condition. Dr. T. Wistar White felt certain that the kidney condition was caused by the suppurating focus in the nose. She gradually improved and cleared up. Cultures from the nose showed pure staphylococcus albus.

"Case 2.—A six-year-old child was admitted February 5, 1922, to the St. Louis Children's Hospital, with swelling of face, eyes and abdomen. There was no history of any previous serious illness. About the first of December, 1921, he had a severe cold with profuse discharge from the nose, no cough and did not complain of throat. On December 15th, his condition was diagnosed as acute nephritis. The urinary output at this time was 60 cc. per day with albumin 4 plus and casts. He was put on milk diet and for a while the swelling decreased and the urine improved. About February 1, 1922, the patient developed a head cold and sore throat and his mother noticed that his abdomen was swelling again.

"Physical examination on admission showed eyes swollen, abdomen large and patient very listless. Small amount of bloody discharge from right nostril, mucous membrane reddened with strings of mucopus everywhere. The tonsils were large but not acutely inflamed.

"February 6th, there was complete anuria; the next day the output was 150 cc. The nose was treated with aqueous solution of phenol and iodine, and on the following day there was less swelling of eyelids. On February 11th, the patient was much brighter and the output was 650 cc.; edema of the ankles was less. Nasal irrigations three times daily. February 13th,

complete anuria, complained of pain in left ear. February 14th, less pus in the nose, left tympanic membrane bulging. The 15th, the left tympanic membrane opened with free drainage of pus. Edema marked. On the 17th, there was an acute otitis media with free drainage. On the 18th, the urinary output increased. It is certainly evident in this case that edema increased parallel to the infection and that treatment depends upon the removal of the focus.

"On February 21st, he voided approximately 1,000 cc. in twenty-four hours. There was less discharge from the nose and the temperature was normal. No note of change in edema. On February 22nd, the child was much brighter; urinary output, 1,200 cc. Weight, 52 pounds. On the 26th, his temperature went to 104° F., and there was a small white patch on the left posterior pillar. The right tympanic membrane showed a tendency to bulge. K. L., negative. On the 28th, the temperature was 103° F., and there was considerable amount of pus in the nose, which was apparently coming from both antra. The following day the temperature remained the same, and there was marked ascites with scrotal edema. On March 7, 1922, the temperature was 105° F. A trocar was inserted under gas anesthetic and considerable pus removed from the left antrum by irrigation. On the 10th, there was a loss of three pounds in weight and the temperature was down to normal. On the 14th, there was very little pus in the nose. On the 16th, the temperature was normal. The nose had cleared up and the edema was gone. The urine still showed a large amount of albumin, a few casts and no blood. On the 17th, there was a considerable amount of pus in the nose. The eyelids were puffy. On the 20th, there was not so much pus. Both antra were irrigated and culture showed staphylococcus. On the 25th, there was a gain of three pounds; slight puffiness of the face, and abdomen seems a little larger. The antra were probably filled with pus again. On the 27th, there was considerably more pus in both middle-meati than was seen on the previous examination. Considerable mucus was removed from each antrum on irrigation. On April 4th, the patient looked distinctly more edematous. Both antra irrigated and a large amount of pus recovered from both. Cultures show staphylococcus albus. On the 10th, there was less pus in the nose and

he had lost a pound and a half. On the 13th, the weight went up again to 50.5 pounds. The face was very edematous and the eyes closed. There was free fluid in the abdomen, nose was swollen and completely stopped up. Both antra irrigated. On the 15th, the patient looked brighter, less edema, nose clearer. On the 18th, the patient was very much better, nose clear and free from pus. On the 20th, the urine was still strongly positive for albumin and casts, had lost weight steadily for the last four days, now 47.9 pounds. Edema and general condition much better. On the 25th, he still had considerable secretion in nose. Culture showed staphylococcus aureus, a gram negative coccus and a gram positive bacillus. On May 3rd, the antra were irrigated and there was very much pus, the weight increased and there were signs of edema in face and legs. Many casts in urine and strong albumin reaction. On the 9th, his nose was full of pus, right antrum irrigated and large quantities of heavy pus returned. On the 12th, there was very little pus seen in either side, nose much cleaner.

"Discharge Note.—The persistence of albumin and periodic rise in temperature accompanied by return of edema made us quite certain that there was a focus of infection which kept up the nephritis. It was found to be in the sinuses, especially the antra, and these were repeatedly punctured and irrigated. It was a striking fact that as the pus accumulated in the nose and the temperature became elevated the edema would increase. The patient was discharged May 13th, under protest, after having been in the hospital for three months. At that time there was no edema and the nose was free from pus. He was on a liberal diet with only salt restricted. The maximum N. P. N. was 45 and the minimum 40.

"We have heard from the patient within the last month and he apparently is getting on very well.

"Case 3.—A four-year-old girl was admitted to the St. Louis Children's Hospital on September 20, 1922, with a complaint of kidney trouble. She gave a history of having had whooping cough, chickenpox and influenza. She is subject to frequent long lasting colds, accompanied by cough and sore throat.

"Last June she went in swimming and a few days later her mother noticed a swelling in her legs and eyelids. The urine

at that time was scanty and loaded with albumin. She was treated at home with various dietary measures.

"On admission physical examination showed a well developed pasty complexioned little girl with general anasarca. Her weight was 20.5 kilos, the urine contained a very large amount of albumin, hyalin casts and the output was markedly low. The tonsils were large and cryptic, no exudate. The cervical glands were somewhat enlarged on both sides.

"Adenoidectomy and tonsillectomy on September 22, 1922; adenoids were found to be quite large. Following operation edema of the face and limbs became even more marked. The urine still contained heavy traces of albumin.

"On October 6, 1922, when I first saw her, the right side of her nose was filled with pus and crusts of the same character as we had noted in two other cases of a similar nephritic condition. The antra were irrigated and were apparently clear. There was a stream of pus coming down from the left middle turbinate—i. e., from the upper nasal cells. Cultures showed staphylococcus albus. Nose was ordered sprayed twice daily with 1 per cent mercurochrome.

"On October 7, 1922, the weight was 20.15 kilos, the output of urine was 75 cc., the albumin was plus 4, flooded with hyalin casts, a few erythrocytes and many white blood cells. The edema was so marked that her eyes were practically closed, and the skin over the abdomen and legs was very tense and shiny. Her diet was very restricted and was entirely salt free. This statement covers the situation back as far as September 26, 1922; in fact, her diet had been so restricted since September 20th. She also had previously been treated along similar general lines from a dietetic standpoint without any definite improvement.

"On October 8th, the urinary output was 150 cc., and weight was 20.09 kilos. On October 9th, output was 570 cc., weight 19.8 kilos, and the left thigh appeared to be smaller. On October 12th, the output was 1,300 cc., and the weight 13.5. During this period a treatment was adhered to of strict diet, salt free, and local spray of nose with 1 per cent mercurochrome twice daily. The urinary output improved greatly, there was less albumin, no casts and no white blood cells. On the 13th,

there was no albumin and microscopic examination was negative in every way. Urine was considered surprisingly clear, but the nurse declared that the specimen under question was from this patient. There was still some pus in the nose, but it showed a great improvement over the first examination.

"The weight continued to decrease until on the 16th it was 12.72 kilos. On the 15th, Dr. Mettle made a note that the child had made an almost miraculous improvement. In the space of forty-eight hours she had put out a large amount of urine, with a corresponding loss of weight and edema. The edema and ascites had practically disappeared, and the urine was negative, both chemically and microscopically. Diet was ordered increased and a proposed nose operation postponed because of the great improvement. It was apparent at this time that the betterment of the general condition and of the nasal findings was coincident.

"On the 16th, there was very faint trace of albumin, occasional red blood cells and casts. On the 17th, there was still considerable pus in the nose, and microscopic examination of the urine showed two or three hyalin casts per low power field, a few red blood cells and white blood cells.

"On the 18th there was a note that the albumin had increased, and on the 19th the weight was found to be increasing fairly rapidly, together with the increase in albumin. Weight was now 14.54 kilos and the output 450 cc. Pupils were dilated but react to light and accommodation. An increase in edema was noted and the question of possible mercurial irritation of the kidney considered. Use of mercurochrome was ordered stopped for two days. Nasal findings on the 19th showed a considerable stream of heavy, yellow pus issuing from the left sphenoid region, and the posterior wall of the pharynx was covered with pus. No pus was to be seen elsewhere in the nose and throat.

"The patient was about the same on the 20th, albumin slightly increased, with numerous granular casts, but no red blood cells. Weight, 14.5; no output measurement made. On the 21st, there was less albumin, many red blood cells and weight was 14.31. The weight remained practically the same, being 14.4 on the 24th. The urine gradually cleared up so that it

was entirely negative on the 28th. Nose and throat examination on the 28th showed a thin film of pus on the left side above the middle turbinate.

"The child remained in the hospital on regular diet for about two weeks without recurrence. She is growing normally and appears to be in perfect health."

DISCUSSION.

DR. L. W. DEAN was much interested because he had had an opportunity to treat a number of cases of nephritis in infants and young children who had suppurative paranasal sinus disease. His results were just the opposite of those obtained by Dr. Arbuckle. All the cases treated, however, were cases of subacute or chronic nephritis. Dr. Dean has been informed that in Portland, Oregon, the same good results in nephritis in infants and young children as reported by Dr. Arbuckle were secured by treating suppurative paranasal sinus disease.

DR. EDWIN MCGINNIS was much interested because this was confirmatory of some work Dr. Carey had been doing on some interesting cases, the bacteriology of the nasal sinuses and not the pathologic condition. They found the staphylococcus aureus hemolyticus and experimentally could also get a nephritis from an intravenous injection of the bacteria. Recently in the practice of Dr. Gill he had seen a case of staphylococcus aureus antrum infection and cleaning up the antrum eradicated the nephritic condition. He thought that cases of nephritis should be referred to an otolaryngologist to see whether there was a staphylococcus aureus hemolyticus infection in the nose, and whether clearing up this infection would cause a disappearance of the nephritic condition.

DR. MILLARD F. ARBUCKLE, St. Louis (closing), said that giving gas to these children did not seem to injure them in any way. He believed it to be a general toxic condition of all the cells of the body and not of the kidney alone, and that it was the cause of a disturbance of cell tension. Their bacteriologic work was being done but was not complete and consequently he did not wish to mention it.

DR. NORVAL H. PIERCE presented a further report on

"A New Method of Closure of the Eustachian Tube."

DR. PIERCE thought all would agree that it was a consummation devoutly to be wished to have a method whereby the eustachian tubes could be closed with a degree of certainty. He started the work just after the war, where they saw the marvelous things that could be accomplished by means of flaps in the closure of facial injuries. There were two problems to be considered: First, the closure of the tube and, second, the fixation of the flap over the tympanic end of the tube. He started in by knotting a strand of catgut and passing it up the eustachian tube after attaching it to a bougie, the knot being sufficient to hold well in the isthmus, and then it was withdrawn through the nose and cut off and then drawn up again into the nose through the tympanic cavity and cut off there. This proved unsatisfactory because it often did not hold and he then thought of using a flap. The taking of a flap from the posterior surface of the mastoid was an old procedure. It occurred to him that by fixing the catgut in the isthmus, the end projecting through the cavum would be sewed through this flap and by anchoring it with a split shot it could be held in contact with the tubal opening, the tube to be well curetted and the tubal cells well broken down, so that there would be a raw surface to which the flap could adhere.

He had had seven cases and there was no failure so far as he knew. There was one failure in a case he had not seen since shortly after the operation. That case was in a child who had been operated upon previously, and there was a scar and a fistula from which pus was discharging. The child was tuberculous and the operation did not go well. The stitches had to be removed a day or two after the operation from the wound behind the ear, and there was a wound which healed by granulation. When he saw the child, about two weeks after the operation, there was no sloughing, but he had been informed that this had occurred since then. The operation was not so well adapted to cases where a mastoid scar existed. The elevation of the tissues for the flap was much more difficult, and there was no doubt that nutrition of the parts had been so materially decreased that failure might follow by a

sloughing of the flap. One charming young woman had a lock of hair growing out through the meatus as a result of the hair being caught in the flap. The last patient operated by this method was dry in a comparatively short time, and the hearing was very markedly improved. All the cases were carefully tested out as to the cochlea, vestibular apparatus and the stapes, for if there was ankylosis of the stapes no improvement could be expected. In his opinion a carefully performed radical operation increased the hearing for a considerable time. Naturally, the hearing would decrease with advancing years and as the stapes becomes fixed, but this had nothing to do with the radical operation. There had been no relapses in his small series of cases and the tubes had been sealed. Only time could tell whether the operation would be of any great benefit.

(Dr. Pierce then showed a series of lantern slides illustrating the various steps of the operation.)

DISCUSSION.

DR. ALFRED LEWY said the numerous methods devised for closure of the eustachian tube indicated by their number how difficult it was to achieve a reliable closure. According to his observation the several methods of curettage, and skin grafting, whether primary or secondary, seemed to make very little difference; the tube closed or did not close apparently under conditions often beyond the control of the operator, even in cases which had had the most painstaking care of the nose and throat.

He had seen Dr. Pierce perform his operation and there appeared to be nothing technically difficult about it. Dr. Pierce had very ingeniously developed a method of applying the well known pedicle graft for the closure of the eustachian tube and it promised well. The one unsuccessful case mentioned by Dr. Pierce he had seen. The boy was a tubercular subject and had recently been operated by himself for a large subperiosteal abscess, at which time the entire mastoid process was found to be occupied by a cholesteatoma which was removed, but no plastic was done on account of the condition of the soft tissues. At the secondary operation Dr. Pierce undertook the pedicle flap operation but the stitches all sloughed. It was, of course, altogether an unfavorable case for this operation.

The latest book on otology seen by Dr. Lewy, that of Dan McKenzie, who attempts to close the eustachian tube by a primary Thiersch graft, stated that many of his cases discharged for six months, and about 25 per cent continued to discharge indefinitely. He believed that any method that promised definite closure was worthy of serious consideration. The only thing he could think of that would keep Dr. Pierce's operation from universal adoption in properly selected cases would be for Dr. Bárány's operation to prove successful. Dr. Bárány, as they all knew, treated the mastoid cavity and the tympanic cavity as separate entities, and endeavored to obtain separate closures of the mastoid by granulation and then treated the tympanic cavity as necessary. If this technic proved successful, of course the pedicle graft for closure of the eustachian tube would be unnecessary.

DR. GEORGE E. SHAMBAUGH thought that of the numerous suggestions that have been offered for securing a permanent closure of the tube the one offered by Dr. Pierce seemed to assure the best chances of success. He had never been able to get very much excited as to whether the tube remained open or closed after the radical mastoid. In the first place, in those cases where there is a persistence of moisture after this operation, it was only in a few of these where such persistence could be reasonably attributed to the nonclosure of the tube. One should always explain to the patient before undertaking the radical mastoid operation that this operation is not done because of the discharge alone, but it is undertaken in some cases of persistent discharge because in connection with this discharge the examination has convinced one that there exists a dangerous focus of infection, a caries or a cholesteatoma hidden away in the attic, aditus or antrum, and that the operation is undertaken for the elimination of this focus which is recognized as a distinct menace and a possible cause for a serious intracranial complication. As a matter of fact, when the radical operation has been properly carried out and the condition described above which constitutes a menace has been eradicated the object for which the operation was undertaken has been accomplished. Should there persist a moisture in the tympanum because of local conditions here, or because of a patulous eustachian tube, that was no indication that the

object for which the operation had been undertaken had not been attained. It should not be a difficult matter to explain this situation to the patient.

DR. SAMUEL SALINGER expressed his pleasure at having heard the paper and at having seen the pictures, which made plain many refinements in the details which he had not understood before. A short time ago Dr. Wittmaack published an operation very similar to that described by Dr. Pierce, in which he stated that he had performed this operation on 100 cases, in the majority of which he had obtained a splendid result. Dr. Salinger had tried it in two cases at the County Hospital, in both of which the flap had sloughed. He thought this was not due to the operation but to the operator, for he could see that several differences existed in the technic as they had performed the operation and that demonstrated by Dr. Pierce. In one case they did this operation on one side and the flap sloughed; a few weeks later they performed a radical mastoid on the other side and did the Bárány operation with very good results. They have done two subsequent operations by the Bárány method with excellent results. In all the cases they found an incomplete pneumatization and very shallow mastoid cavity, so all they had to take care of was the aditus and tympanic cavity. In both cases the posterior wound seemed to heal up by granulation, and the tympanic cavity derived its covering from the intact meatal covering. He thought in this type of mastoid (sclerosis with few or no cells) any plastic was unnecessary, for by leaving the membranous meatus intact the shallow mastoid cavity was shut off from the meatus, healing by granulation, while the epidermis grew in more rapidly to line the tympanic cavity and tubal opening.

DR. EDWIN MCGINNIS said that at the last meeting of the Clinical Congress of Surgeons held in Boston, Dr. Smythe demonstrated a new radical mastoid procedure. He makes a flap of the posterior portion of the external canal. This could be used to sew into the eustachian tube by the Pierce method. He exhibited four or five cases, and there was no sloughing of the flaps, and the results were excellent.

DR. ROBERT SONNENSCHNEN said he had had the privilege of seeing Dr. Pierce perform one of these operations and that it was a very beautiful performance. While it was true, as

Dr. Shambaugh stated, that it was not absolutely essential to have a perfectly dry ear, it was a great desideratum, and if this or any other method would give a dry ear it would be very pleasant, especially from the patient's standpoint. He thought all would agree that in the performance of any radical mastoid very careful attention to detail was necessary or the result would not be satisfactory. Not only the operative skill which Dr. Pierce possessed but his very careful attention to the details of after-care probably accounted for his success.

DR. CHARLES H. LONG reported a successful closure of the tube by skin grafting, according to the technic of E. Hamilton White of Montreal, which was published in the *Journal of Laryngology and Otology of Edinburgh, Scotland*.

On August 24, 1922, a radical mastoid operation was performed on a male patient fourteen years of age. On September 7th, or fourteen days after the radical operation, an exact cast of the bone cavity was made by pressing into it a piece of modeling compound. When this hardened the cast as removed and a skin graft taken from the arm was laid over it with the cut surface outward and it was then pushed back into position. Seven days later the cast was withdrawn through the retroauricular opening. November 15, 1922, the eustachian tube was found closed and the ear was dry. At no time had the patient experienced any pain or discomfort. Both cases reported by Dr. White had dry ears in less than a month after operation. He made no mention of the condition of the eustachian tube. Further experience was needed before this simple procedure could be recommended as a regular method for closure of the eustachian tube, or for shortening the usual long drawn out after treatment or postoperative mastoids.

DR. HARRY L. POLLOCK thought that so few of the radically operated ears discharged from the tube that it was not necessary to attempt to close the end at the time of the operation. Of course, it was better, but there was only a small percentage that gave any trouble. A few weeks after the radical operation it was very simple to close the pharyngeal end and in those cases where the persistent discharge occurred they closed it up with little trouble in every case simply by pulling out the mucous membrane of the pharyngeal end and clasping it together. In practically every case the eustachian tube closed following

this and there was no further trouble from discharge in the mastoid cavity. If every radically operated ear had this trouble Dr. Pollock thought it would be necessary to close the tube, but the percentage was so small that it was no trouble to close the tube afterward. He had never attempted the operation described by Dr. Pierce, but if it was so simple he believed it should be done at the time of operation rather than four or five months later. He saw no reason why it should not be successful in every case.

DR. NORVAL H. PIERCE (closing) said that Dr. Shambaugh claimed that he was not worried about a discharge after a radical operation. Dr. Shambaugh was not the one to be considered—it was the patient, and the patient worries. The patient regards a running ear after an operation as a failure in the operation. He thought it was true that the factor of a running ear had been eliminated as a fatal issue, but he disagreed with Dr. Pollock that these running ears occurred so infrequently that it was a matter of no importance as to the closure of the tube. The literature gave from 45 to 60 per cent of failures as to running ears after an operation.

It was true that Wittmaack published an operation a little while before Dr. Pierce's was published, but the operations were different to the extent that Wittmaack does not fix his flap as Dr. Pierce fixes his, in the mouth of the eustachian tube, and Dr. Pierce thought this was perhaps the most important part of the technic.

Regarding the operation of Professor Bárány, that was probably done on cases which he would not operate upon at all; cases of arrested pneumatization with a slight discharge from the ear did not require an operation, and where a large cavity existed with a large cholesteatomatous mass this operation was not to be thought of and one did not have to have any experience with Bárány's operation to realize this. That conclusion had been going on for years and years. Schwartze, who inaugurated operations on the mastoids, treated the chronic cases in just about the way Professor Bárány does at present. He made no flap, but treated the wound from back of the ear, and the failures in these cases were so numerous that the radical operation was devised to more frequently insure success. He thought all would agree that if one operation could accomplish

what two would do it was better to do it in one. Dr. Pollock required a second operation with the method mentioned by him, and so also did the method mentioned by Dr. Long, but the one stage operation was surely to be preferred.

DR. GEORGE W. BOOT said that as Dr. Bárány was not present to defend himself, he thought someone of those who took his course should mention the fact that Professor Bárány stated definitely that he performed his operation in cases of cholesteatoma.

DR. PIERCE, replying to Dr. Boot, said he did not wish to assault Professor Bárány. He said, and repeated, that the operation as performed by Professor Bárány was, in his opinion, inapplicable to large cholesteatomatous growths in the mastoid.

DR. AUSTIN A. HAYDEN presented a paper entitled:
"Fifth Year Oto-Laryngology in General Hospitals."
 (Preliminary Presentation.)

ABSTRACT.

The scope of this paper was limited to the consideration of otolaryngology in the graduate, hospital or fifth year medicine. Postgraduate teaching is entirely another matter which Phillips, Shambaugh and others have dealt with ably and thoroughly. The term "General Hospitals" was meant to include the typical average better grade institution of 100 beds or more with rotation interne service, the men serving successively for given periods of time in the laboratory, obstetrical, medical and surgical departments. This excluded special hospitals and those with single nonrotating house services, where a whole year is spent in one department, as well as those having a special eye, ear, nose and throat interne while the rest of the house staff rotates.

The teaching in diseases of the ear, nose and throat should properly come from the attending otolaryngologists.

The fifth year requirement, inaugurated a little more than a decade ago and still largely in the formative period, had in reality created a new national American medical school whose field is just above the undergraduate and just below any sort of postgraduate instruction or the years of practice that are to follow. It is an in between period in which the student is no longer a student on the benches, nor is he yet a full fledged

Doctor of Medicine. The student body numbered 2,529 last year. It would be considerably larger in 1922-23. The average age was somewhat over 27. The per capita investment had been variously estimated as between \$10,000 and \$20,000, or from \$20,000,000 to \$40,000,000 in all.

Dr. Hayden said that to present a complete survey of this whole subject would be manifestly impossible and entirely inadvisable, and after analyzing the actual otolaryngologic work done in a 166 bed hospital, with which he was familiar, he gave the following conclusions:

"1. Otolaryngology forms a very considerable part of the work of the average general hospital. For that reason internes are entitled to a proportionate amount of training in this department.

"2. A curriculum carefully worked out by otolaryngologists and followed by them in their own hospitals would equip the general practitioners of the future with a broader and more practical knowledge of the diseases of the ear, nose and throat.

"3. From these more systematically trained physicians undoubtedly adequate numbers would be attracted to this specialty after having spent a number of years in general practice or suitable postgraduate work.

"4. If advantage is not taken of this opportunity otolaryngology will gradually but surely lose its identity as a specialty and be merged into general surgery or general practice.

"5. A standardized curriculum for systematic fifth year instruction in all departments of general hospitals might prove to be as long a step forward in the further development of modern medicine as was the standardization of the medical college itself. Otolaryngology, if it will but lead the way, can render great and lasting service to organized medicine."

DISCUSSION.

DR. GEORGE E. SHAMBAUGH said that he considered the subject presented by Dr. Hayden as an extremely timely one. We need more discussions of subjects of this type.

The primary question brought up was this: What should be attempted in the general hospitals along the line of educating the internes in otolaryngology? Dr. Shambaugh felt that the solution of this question was not difficult, especially for

those who have been interested in the subject of instruction in otolaryngology for undergraduates. This point should be kept clearly in mind, namely, that the fifth or hospital year should not be looked upon as a graduate year, but as a part of the undergraduate medical training and as intended to round out the clinical experience of the undergraduate student where the work in the previous years had, in a sense, fallen down. When planning the work for the fifth year in hospitals this fundamental fact should be kept in mind, that the object of undergraduate work in medical training is to prepare men to be general practitioners. There is no place for specialization in undergraduate training. This should apply as much to the hospital year as to the previous years' work. Those who are most interested in medical education are at one in the opinion that the training for undergraduates in the various special fields should not include training in operative technic. For example, in otolaryngology the aim should be to train the undergraduate medical student how to carry out the simpler examinations; also to present to him the various clinical problems encountered in this special field, but it is a mistake to try to teach him surgery in the ear, nose and throat. He was inclined to believe that the general surgeon has been slower to appreciate this fundamental fact in undergraduate medical training. He believed that what is required as applied to the operations on the ear, nose and throat applied in equal force to general surgery. The principles of either one of these subjects and the problems encountered in practice are proper subjects for introduction in the undergraduate curriculum. Operative courses and surgical clinics should be largely dispensed with. These should form an important part of graduate training for those who are going into special practice; whether this be otolaryngology or general surgery, it is one and the same thing.

Regarding the field of otolaryngology, Dr. Shambaugh felt that a great deal of harm is being done by efforts to teach the general medical student the technic of operations either in the college years or in the fifth year. One should always bear in mind that it is a relatively simple matter to teach a man how to do an operation, but it is much more difficult to teach him to recognize when to do these operations. It has become the practice in some general hospitals to allow the internes in their

regular fifth year's work to do operations in the nose and throat, the idea being that these are minor procedures and that the technic can be readily mastered. It is, for example, a simple matter to teach a person to do a turbinectomy, but anyone trained in otolaryngology recognizes that it takes many, many months of constant study of clinical patients to instill into the student's mind an appreciation of the proper indications for a turbinectomy. All this applied just as truly to the question of adenoids and tonsils. To train general practitioners in the technic of operations in this special field was only preparing men to increase the flood of unnecessary operations on the nose and throat, and particularly upon the tonsils, that has been flooding the country in recent years.

Dr. Shambaugh stated that he was very much interested in training men in otolaryngology, but he did not approve of teaching general practitioners the operative work before he had some assurance that they had studied the subject long enough to understand the indications for operations.

DR. JOHN MILTON DODSON found himself thoroughly in accord with Dr. Shambaugh about the limitations of the field and agreed heartily with him that the intern year was not a graduate year at all. One of the reasons given for making it a requirement for graduation was to emphasize that very fact. He thought all would agree that no young man could safely be trusted to go into independent practice before having practiced for a considerable period under the immediate supervision of an older, more experienced man. That experience he obtained in the older days under the preceptor system. When the preceptor plan, for various reasons, fell into disuse he could obtain this training only in a hospital, but there was a considerable period between the time of the preceptor era and the development of a sufficient number of hospitals, so that, during this interval, a large proportion of the graduates in medicine went into general practice and secured their training and experience on the patients who came under their care. Some twenty years ago the practice of medicine began to be hospitalized and these institutions began to increase rapidly in number. The interne year was not new. For fifteen years the majority of students have sought to secure and serve internships. The few schools that have taken the step in the last

five or six years to make it a requirement for graduation have done this in order to get the interne year under supervision of the faculty so that they may advise them and assist them in the selection of internships and thus get some control over the work they do in the hospitals and, secondly, supervise this phase of the hospital's work. The great purpose of the movement is to make the hospitals do better work, have better supervision over the interns and realize their responsibility to the internes.

Dr. Dodson thought Dr. Hayden's figures were rather excessive, that the average expenditure of medical students would not be as high as he indicated, but they had invested enough. They had reached the age of twenty-seven, in most instances, when they entered the hospital to give hard service for a year to fit themselves for the practice of medicine and they were entitled to close supervision and all the assistance the members of the staff could give. The only way to get good and efficient service was to give the necessary time to the internes.

As to the number of internes required, he thought Dr. Hayden's figures were far too small. The 428 hospitals that had been approved by the Council on Medical Education of the A. M. A. by no means represented the thousands of hospitals in the country that needed internes and were entitled to them. If all the hospitals which could provide reasonable opportunities were to demand internes in the right proportion—not over twenty to twenty-five beds to the interne, especially on the medical side—the number of internes would not be anywhere near sufficient. The acute problem was how to provide resident services for all of the hospitals, which are rapidly increasing in number. The number of graduates was not going to increase and it was only about 3,000 a year.

When asked what time shall be given to otolaryngology in the fifth year the question arose, What are we making of them—specialists? He hoped not. They were trying to make the good old family doctor, who was said to be passing but without whom he did not believe the world could get along. Every medical man should know some otolaryngology as related to medicine, and he still thought they could best be taught this by an otolaryngologist, but was beginning to question this a

little. If the interne saw the medical man in the hospital needing the assistance of all these specialists, how was he ever going to get along in the country, where he must examine the ears and the nose and the eyes of his patients and have at least some degree of experience in the special lines? Dr. Dodson thought the otolaryngologist should do a certain amount of teaching, but he should bear in mind constantly that so far from attempting to teach the technic of the operations to the young men he should be constantly emphasizing the fact that they should not attempt many of these operations. It was not a question of knowing how to operate but when to operate. He believed no man should hold himself out to the public as fit to undertake these operations until he had been at least five years in general practice, and then had spent at least one, preferably two, years under favorable conditions for special training in that particular line. This seemed a long road, but the rewards would be much more in proportion, if one could judge from the fees charged, than the fees the country doctor got for the preparation he had to make.

Dr. Dodson thought it was hard to see how the students could be taught much otolaryngology in the fifth or hospital year. One must remember in the fixed services that the hospital, even a teaching hospital, has obligations other than those to the patient. The hospital is first of all for the care of the sick, and no other phase of its activity can be permitted for a moment to prejudice in any way the welfare of the patient. There was no question that for the patient's interest and for the comfort of the attending man the service of a young man for a whole year in one department—e. g., medicine—is much better than service in a department for only two or three months. Under this latter rotation plan, he is just beginning to get fit when he is shifted to something else. The young man should follow a year by a year or half year in surgery; it made little difference whether in special or general surgery, but he should learn the principles of surgery. Even in the rotating service Dr. Dodson could not see how anyone could teach much otolaryngology unless the student was restricted entirely to that service, as he is at the County Hospital for three months. At present a man may finish his County Hospital service without any work at all in otolaryngology or some

other of the specialties, but Dr. Dodson thought this not a serious matter.

What was the solution? He believed it was in the very beginning of the organization of the interne year and thought the time was coming soon when hospital staffs must be organized into an intelligent teaching unit. Not that they should organize into a lecture bureau and harangue the students, for they had had enough of that in the medical school, but he thought it should be possible to so arrange the work that an interne on the medical service should have an opportunity to learn all he needed to learn in otolaryngology and ophthalmology while serving his year as a medical interne. He was not quite clear as to just how this could be brought about, but felt that a young man who served after four years of medical training, in residence, a year or two of internship in a hospital should go out with a good training in some one line and a reasonably clear knowledge of the special branches of medicine, and that the staffs of the several hospitals where internes go should be alert about this matter, should recognize and give study to the pedagogics of the interne year, just as the faculty of the undergraduate school must do in order to get good results.

DR. J. HOLINGER said he had been connected with internes in general hospitals for more than twenty-five years, and his experience was that the question how much an interne learned and how much he missed was largely personal. Some internes took to the work like a duck to water. They went into it with a will and were glad of an opportunity to learn. They would take patients into the examining room, examine them and after a time come back with questions, and it was a pleasure to teach them. By far the largest number try to dodge such work and do as little as possible. He believed that if the colleges expected the hospital staffs to do something for these boys they should give the members of the staffs the authority of making the boys do their share. Many internes acted as though they did you a favor when they listened to your teachings. If an interne became too selfconscious and overbearing, Dr. Holinger asked him to examine a patient and tell what he found. Some recognized their shortcomings; others would find some excuse to get away. In his opinion, all students should have

an idea of the technic of a general examination of the ears, nose and throat. This they were entitled to. They should know a drumhead when they see it, the main parts of the nose; they must know how to handle a head mirror properly, and they should be able to look into a mouth and pharynx without making the patient vomit. Dr. Holinger always found that it was an advantage for the student to have his own forehead mirror and ear and nose specula; then they will use them and learn something. The student should recognize that he is under the supervision of the staff and give as much assistance as possible.

DR. ROBERT SONNENSCHNEIN thought one of the crucial facts was that in the past few years there apparently had been a different method of specializing, at least so far as time was concerned. In former years the men who were recognized as specialists were those who, after leaving the hospital in which they had served an internship, had taken a course in some special branch or had worked with a man doing such work on the living or the cadaver before proclaiming themselves as specialists. This took from two to five years, and many of these men had practiced general medicine for several years, thereby fitting themselves better to specialize in some particular branch. In the last four or five years a great many of the younger men had specialized immediately upon leaving the hospital. He had the honor of being connected with a hospital with rotating services, and if one examined the operating room schedule at that hospital it would be seen that an enormous percentage of the operations being performed were by men other than specialists or by very recent exinternes and graduates who came in and did turbinectomies, tonsillectomies, etc. In this hospital, and probably in many others, in order to get any service from internes it was necessary to give them practically all the operations on the ward cases. If through the kindness of the men on the staff the internes could be taught the technic of the operations they may have to do if they expect to do country practice, or if they intend to take up a specialty, it was all very well, but, on the other hand, it was a question whether all the operations must be turned over to the internes. He believed that on a rotating service of three months the attending man could teach the functional tests of

the ear, the examination and even the operating in the parts assigned to otolaryngology.

Dr. Sonnenschein believed that the only cure for this generalized operating by internes or any group of them would be for the general hospitals that have a rotating service to have an agreement regarding the operating to be done by the internes. There would then be no advantage in going to any particular hospital merely in order to get plenty of operating whether the man showed by his attention to duties that he deserved the operative work or not.

DR. EDWIN MCGINNIS thought the subject was very important and said that as he had no regular assistant he had worked out a scheme of having a hospital interne act somewhat as an assistant. He had no special anesthetist, so his interne gave his anesthetics for him. He tried to teach these men how to use a local anesthetic and to anesthetize the throat properly so that they might become competent in examining patients and could handle the patient afterward, trying to teach them all the complications that might arise following an operation. He thought it was difficult to do much for the interne so far as the nose was concerned. One could show him the condition of the nose before operation and after completing the operation could show him the picture so that he could get an idea of the "before and after taking" condition. He thought it was surprising how much help could be obtained from internes in this way. He seldom had to go to the hospital to stop postoperative hemorrhage, for his internes were taught how to get the patient to the operating room and could usually control the hemorrhage without difficulty. In his experience with fifteen or sixteen internes not one of them had expressed their preference for otolaryngology. In the last few weeks three young men had come to him and asked how to go about becoming specialists in otolaryngology. He had told them that they should take a general hospital internship and follow this with a postgraduate course at Rush Medical College and then an internship in a hospital where they could do this special work. This would take two or three years and then if they wanted to go into otolaryngology they would be prepared. Dr. McGinnis had rather drifted into otolaryngol-

ogy through his association with Dr. Ingals, after several years in general practice.

DR. L. W. DEAN, Iowa City, said that of his five internes one had had a service in internal medicine; each of the others had had a rotary service. Each of the four internes who had had a rotary service had operated on many cases for the removal of tonsils. They felt that they could do the work well when, as a matter of fact, they were not capable of properly performing the operation. The one interne who had a service in which he had no tonsil work was very much discouraged at first because he felt the other internes were more proficient than he. He was advised that as he had built his foundation well, he was much better prepared for the work than the others. Dr. Dean believed that the performance of operative work by internes before they have been properly prepared for this work could only be prevented by the education of the members of the clinical staffs of the hospitals or perhaps by bringing pressure to bear upon the hospitals to see that these things were done correctly.

A physician practicing in a small town must be able to diagnose suppuration of the middle ear, a diphtheritic or nondiphtheritic throat; he must be able to treat acute laryngitis in the infant, paratonsillar abscess, and many other common conditions. He should know all about the application of various drugs in emergency cases. In order to educate internes so that they get those things which they will actually need in private practice is a problem which can only be solved by some person or persons giving to the internes a lot of time and attention.

DR. GEORGE W. BOOT thought it was impossible to take any one part of the body and separate it from the rest, and that one could not take any part of a hospital and separate it from the other. According to Dr. Hayden's figures, about one-fourth of the hospital cases belonged to the ear, nose and throat department, and the interne taking a general service should be entitled to some knowledge of ear, nose and throat work. The staff was divided into the different specialties, internal medicine, surgery, obstetrics, otolaryngology and so on. In the month of March he had listed eighty-seven medical cases and seventy-seven ear, nose and throat cases, so it seemed

that the interne was entitled to almost as much instruction in otolaryngology as in medicine. Another feature was the limiting of the ear, nose and throat work to specialists. He thought that all medical work was not limited to internists or all surgical work to surgeons.

Still another feature was the fact that thirty-one of the fifty-nine ear, nose and throat operations in March were done by general practitioners, over one-half the work, and Dr. Boot thought these men were going to do this work anyway, and since this was the case they should be shown how to do it, out of consideration for the patient.

DR. NORVAL H. PIERCE expressed the opinion that the interne body was getting very cocky. The internes at a certain Chicago hospital recently held an indignation meeting and demanded as one of their "constitutional rights" that they be given all the tonsil operations. Internes are a necessity. The staff met with them and talked as kindly as possible to them, but it was a drawn battle, and the internes were now deliberating as to whether to continue to serve the hospital or leave the staff in the lurch. They have quite well founded ideas, and among them is the idea that they shall take out tonsils. Dr. Pierce thought that the legitimate indications for a tonsillectomy could be easily acquired. The mere removal of the tonsils did not constitute the main part of the job; it was laying the foundation in an individual of a certain moral standard, and that was a very difficult thing. It was making a man who has a large family and very little money, rather than break through that moral code, tell a patient who did not need to have his tonsils out, "No, you do not need to have them removed," and that was a very difficult thing to accomplish. It probably went even back of the college education or was, perhaps, prenatal. He confessed that he was ashamed of his educational neglect of the internes in the hospital he attended. There was no training of internes. He agreed with the statement of Dr. Dodson that the first requisite of the hospital was the care of the patient. Anything that came in conflict with that was wrong, but they must face the situation of education, not only of nose, throat and ear internes, but the whole interne body. He was inclined to think that within a few years the whole aspect of the thing would change; that there would be

paid trained residents in the better hospitals, which, of course, would give a much better basis for education than the present status of the interne, who was not paid and not appreciated.

DR. JOHN MILTON DODSON agreed that the vital thing to teach any interne was the proper examination of the patients. One of the serious mistakes under the present system was the way patients were assigned. The hospitals and dispensaries were doing the very thing they criticised the general public for doing, letting the patients make their own diagnosis. The patient goes to the hospital and assigns himself—says he has bad tonsils, or bad eyes, and wants to go to that department. They hope soon to have every patient that comes to the dispensary go to the department of general medicine first for a group study and diagnosis as they do in the Massachusetts General Hospital. That is where they belong, because each patient is entitled to know whether he has anything else wrong with him besides what he thinks he has. The interne should not be permitted to report the examination of any case until he has examined the nose, the tonsils, the ear and every other part of the body.

As to the cockiness of the internes, Dr. Dodson thought that was a perfectly obvious result of the demand exceeding the supply and that the only way to overcome it was to make the fifth year a part of graduation, for the interne who does not complete his contract, who does not serve the men on the staff of his hospital, and it is so reported, does not get his diploma and he knows it. On the other hand, most of the faults of the internes and the reports on them are due to the men on the staff. Dr. Dodson did not know any young men who were not anxious to take advantage of any good instruction that they could get. He always told the students that they were not entitled to do any operating unless the attending men thought they should.

DR. AUSTIN A. HAYDEN (closing) expressed his gratification of the general discussion which the preliminary presentation had brought out. He thought Dr. Dodson had misunderstood him as meaning to develop specialists out of the general hospital service. That was not the intent of the paper.

He believed men who were not working in a general open and closed staff hospital did not realize the limitation of such

a hospital. The vast majority of the hospitals in the United States today are such institutions as he had described. There were only two hospitals in Chicago that had the single, non-rotation service, the Presbyterian and St. Luke's. These men are going out with an unlimited license to practice any sort of medicine that their patients bring to them to take care of. He remembered an interne whose first operation was a Cesarean section. He believed the first thing the average young man would be called upon to do would be to take care of an obstetric case. They could do this much better for the patient if they had been properly trained in obstetrics by an efficient obstetrician. By the same token, he believed that any interne was soon going to take out some tonsils, probably not quite so soon if he located in Chicago, although Dr. Hayden did not believe that the practice of medicine in Chicago differed intrinsically from that in the rural districts. He felt that if the interne had been as well grounded in the hospital as time would permit by such men as constitute the membership of the Chicago Laryngological Society he would do much less harm to the patients who came to him in private practice.

In his opinion the day of the old family practitioner had entirely passed, or at least he had been supplanted by a new variety of medical man. He remembered the equipment his father had in Southern Wisconsin. There were few nose and throat instruments and the obstetric forceps had a much more prominent place. Conditions have changed, and the man who goes out today very soon develops into an all-round specialist as well as general practitioner. The training that could be given when carefully supervised was something that the interne had a tendency to feel that he had a lien on and that he was really entitled to that teaching, inasmuch as otolaryngology constitutes a very considerable portion of the work of any well balanced general hospital.

CHICAGO LARYNGOLOGICAL AND OTOLOGICAL
SOCIETY.

Meeting of Monday Evening, January 8, 1923.

THE PRESIDENT, DR. CHARLES H. LONG, IN THE CHAIR.

DR. CHARLES H. LONG exhibited a patient with

Hare-Lip and Cleft Palate.

The patient was a Norwegian man, aged 34 years, who was born with a cleft palate and harelip. He had had nasal obstruction since birth. The family history was negative. He was one of seven children, three of whom were dead.

The point of interest was the large amount of lymphatic tissue which could be seen in the nasopharynx and nose and the advisability of doing any operation. He had been operated upon for harelip when a baby. His mentality was that of a boy of fifteen but was said to be improving. Dr. Earl Thomas, assistant to Dr. T. W. Brophy; had examined him and expressed the opinion that no operation would be of value at this time. He believed that such apparatus as a dentist could manufacture would do all that could be accomplished.

DISCUSSION.

DR. ELMER KENYON stated that Gutzmann had studied cases with adenoids in connection with cleft palate and had decided that unless there was an extremely good reason for removing the adenoids they should be left alone. If they are removed the voice is invariably made worse, as the adenoids serve as a sort of obturator. Gutzmann thought not much could be said in favor of removing the adenoids, except in cases where breathing space was necessary, when a partial adenoidectomy was the proper procedure. He argued that in the cleft palate class of cases, in which the middle ear was always prone to infection, even with a free nasopharynx, there was not the same imperative reason as exists in cases with a normal palate for removing the adenoids to protect the ear.

DR. LONG (closing) stated that Dr. Sher expected to remove enough of the tissue to give the patient nasal breathing space and that he would then turn him over to the dentist to have the proper apparatus constructed.

Foreign Bodies Removed From the Bronchi and Esophagus.

DR. GEORGE W. BOOT presented some foreign bodies which had been removed from the bronchi and esophagus of various patients. The first was a piece of bone which had been impacted in the throat of a Scotchman who had swallowed it while eating mutton broth. Great difficulty was experienced in dislodging it.

The second specimen was a peanut which a colored boy of three had inhaled and which had been removed from the right bronchus.

The third specimen was another peanut which had been removed from the right bronchus of a boy of three. This was the only patient Dr. Boot had ever had who had died from bronchoscopy. The peanut, which was too large to be removed through the tube, broke in two as it was passing the vocal cords and before he could secure another hold on it the boy choked to death.

The fourth specimen was a tack which had been imbedded in the left bronchus of a baby eleven months old for six weeks.

The fifth was a black headed steel pin, 4 cm. long, which had been inhaled and had shifted to various places. The first picture showed it in the right bronchus. The following day X-ray examination showed the pin in the trachea and the next day in the right bronchus. Every time the boy coughed the pin changed position. When extraction was finally attempted the pin was in the trachea and the boy coughed it out as soon as the bronchoscope was introduced between the vocal cords.

Paper: "The Structure and Function of the Crista Ampullaris."*

By GEORGE E. SHAMBAUGH, M. D.,

CHICAGO.

*See page 443.

DISCUSSION.

DR. J. HOLINGER expressed his thanks to Dr. Shambaugh for his clear presentation of the function of the crista ampullaris and said the intention of physiology has been from the beginning to reduce the complicated functions of the body to simple laws of physics and chemistry. If we did not succeed in this it was either because we did not understand the functions or because we did not know the laws of physics and chemistry which governed these functions. Therefore recourse

was often had to complicated and undigestible theories. He thought very few people could understand Helmholtz's book. The mathematicians say it contains too much physics, and the physicists say that it contains too much mathematics. Siebenmann and others have succeeded in explaining to a great extent the function of the cochlea. Bárány, Jones, Shambaugh, Ewald and others did the same for the vestibule and semicircular canals.

DR. ALFRED LEWY said that Dr. Shambaugh's work and ideas had greatly strengthened the arguments in favor of endolymph flow as the causative factor in labyrinthine nystagmus and allied phenomena, but his theory that the duration of the induced phenomena was dependent upon the duration of endolymph flow failed to explain several things. According to Bárány, after-nystagmus may last anywhere from three or four to sixty seconds or more in normal individuals. It hardly seemed possible that the anatomicophysical conditions that are the causative factors of endolymph flow can vary so widely in normal human beings. There certainly must be a powerful neurologic element. One must consider the varying sensitivity and interaction of nerve cells. Especially unexplained is the fact that in the same individual, under the same stimulation, on different days, or even on the same day, with the question of fatigue eliminated, the duration of nystagmus, and especially of vertigo and nausea, may vary. Nor could it be explained in all cases by the development of inhibitory impulses, as seen in trained aviators and whirling dervishes. As a working hypothesis Dr. Lewy thought Dr. Shambaugh had presented the case very strongly, but one must keep in mind that other elements, largely neurologic, beside end organ stimulation by endolymph movement, enter into it.

Dr. Lewy also wished Dr. Shambaugh to tell something of muscle tonus in people with congenital absence of or destruction of both labyrinths.

DR. ROBERT SONNENSCHNIG said that aside from the fact that Dr. Shambaugh always seemed to have a very lucid way of demonstrating anything, a very important fact to be remembered was that it was the careful study of the anatomy of a structure that would enable one to understand the physiology. He remembered the wonderful specimens produced by Dr.

Shambaugh when he first did work out at the University of Chicago, many of which had been exhibited at the Congress of Budapesth, where they had been much admired and complimented.

One point not mentioned in this discussion but which he had heard Dr. Shambaugh speak of several times, particularly when in Washington at the meeting of the American Otological Association, was the point against the Helmholtz basillar membrane resonance theory as regards the large blood vessel which lies just below this membrane. Since it is known in physics that a resonator attuned to a certain pitch always acts for that tone, one can assume that the basillar membrane, if it is the resonator, cannot act uniformly, since the large blood vessel situated just beneath it would vary in its lumen according to the amount of blood supply running through it and the force of the heart beat.

Dr. Sonnenschein again emphasized the fact that the important thing in addition to those mentioned was that a careful study of the anatomy of any part was essential to the study of the histology thereof, and thereby often its physiology.

DR. GEORGE W. BOOT thought that without any doubt tonus originates in the labyrinth, but he believed there was considerable doubt that it originated solely in the crista. There are three different places where it may originate, the crista, the macula and the organ of Corti. These three end organs are stimulated by different motions. The organ of Corti by stimulation of vibrations in the endolymph, the crista by currents in the endolymph and the macula by movements of the crystals in the otolithic membrane due to their inertia. If the crista is stimulated by pressure, one should be able to produce nystagmus if the canal is blocked off distal to the crista and the patient rotated, for pressure would be produced on the cupola, even though the endolymph could not move. He thought this experiment had never been tried. If the tonus was the result of the to and fro movement of the blood in the vessel, the question was the same as in the eyeball. In the eye one could watch the vessels with the ophthalmoscope and see the vessels under considerable magnification. There is absolutely no movement in the vessels with circulation under normal conditions. He thought the theory that there is to and fro movement of the

endolymph and perilymph with the pulse was not tenable, for if it occurs one should be able to see it in the eyes, where one can see and study the circulation under magnification in an organ less rigid than the labyrinth and where to and fro motion should occur more easily.

Another point was in relation to the duration of the nystagmus. Dr. Shambaugh thought the current was kept up longer because of endolymph in the utricle. Dr. Boot thought this theory was not plausible. If a vessel, a pail, is filled with water and a hole made in the bottom of the pail, the water comes out with a force that has no connection with the amount of water in the vessel but solely with the height of the water.

If a vessel shaped like a semicircular canal and utricle be filled with liquid and rotated so as to set up a current in the canal and then stopped suddenly, there will be no variation in the amount of current set up in the canal with different sizes of vessels.

Dr. FRANK J. NOVAK asked whether the distribution of the nerve fibers in the crista ampullaris had been determined histologically and what the histologic structure of the cupola was. Also what was the effect, if any, of vascular hypertension and various heart lesions, such as aortic regurgitation, or labyrinthine tonus.

Dr. GEORGE E. SHAMBAUGH (closing) said that any one of the questions asked opened up a field for possible endless discussion pro and con. He believed that the explanation which accounts most readily for the phenomena was the nearest to the proper solution. In order to get anywhere with such problems it is most important to keep our explanations as simple as possible, for only in this way can progress be made.

Dr. Lewy's questions were very pertinent, and Dr. Shambaugh was sure that the duration of the nystagmus, as compared with the duration of the endolymph current, is sometimes modified by outside nervous conditions. This is especially true in pathologic conditions.

Regarding the disturbance caused by destruction of tonus, the sudden destruction of one ear produces a profound disturbance of equilibrium; a nystagmus develops with the slow component to the diseased side. This disturbance quickly disappears. What happens? First, we must remember that tonus

to skeletal muscles is not all of labyrinthine origin. Extralabyrinth tonus is an important factor. All of these tonus impulses pass through Deiter's nucleus. When the labyrinth is destroyed there is a complete blotting out, not only of the labyrinth tonus on this side, but by what is spoken of as diachisis, there is a temporary depression of the extralabyrinth tonus; within a short time this depression from diachisis disappears and there is left only the loss of the labyrinth tonus. This is adjusted in one of two ways, probably both acting together. In the first place, it seems likely that there may be an increase in the extralabyrinth tonus to take the place of the impulses to the destroyed ear and restore balance. On the other hand, there is ample evidence that the tonus from the remaining ear, which supplies impulses to both groups of muscles, those causing movements toward the same side with the stronger impulses to those muscles causing movements toward the opposite side—after one ear has been destroyed for some time a readjustment takes place, so that equal tonus impulses emanate to both groups of muscles from the normal ear. This is evidenced by the fact that in such cases a rotation toward the normal side produces a nystagmus lasting just as long as the rotation toward the opposite side. An interesting sidelight is thrown on these cases by observing what takes place when there is a sudden loss of one ear in cases where in earlier years there had been a complete destruction of the opposite ear. Dr. Shambaugh has had an opportunity of observing but two such cases. In neither one did there occur that disturbance of equilibrium, vertigo or nystagmus, which accompanies invariably the sudden loss of one ear when the opposite ear is normal.

Dr. Shambaugh did not understand just what Dr. Boot had in mind in his objection to the statement that in the rotation experiment the movement of the endolymph in the semicircular canals was prolonged by the pressure exerted from the fluid in the much larger utricle which is also affected by the rotation but lacks much of the friction from the walls which retards the flow in the canal itself. This conclusion regarding the effect of the fluid in the utricle as well as in the perilymphatic space of the vestibule Dr. Shambaugh considered in the nature of a self-evident fact.

